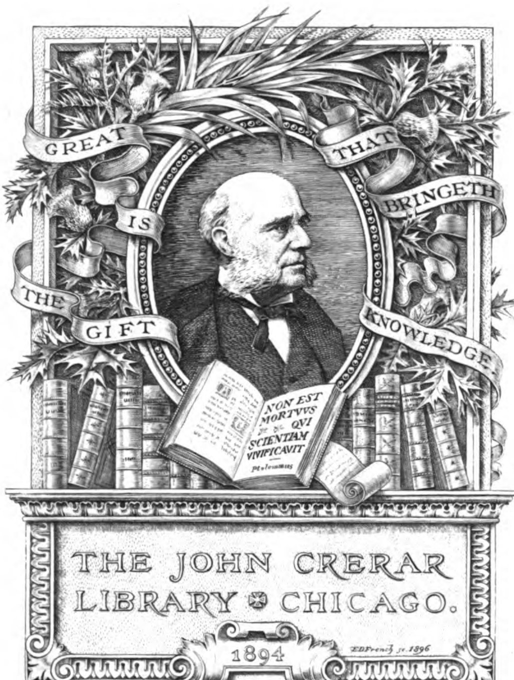
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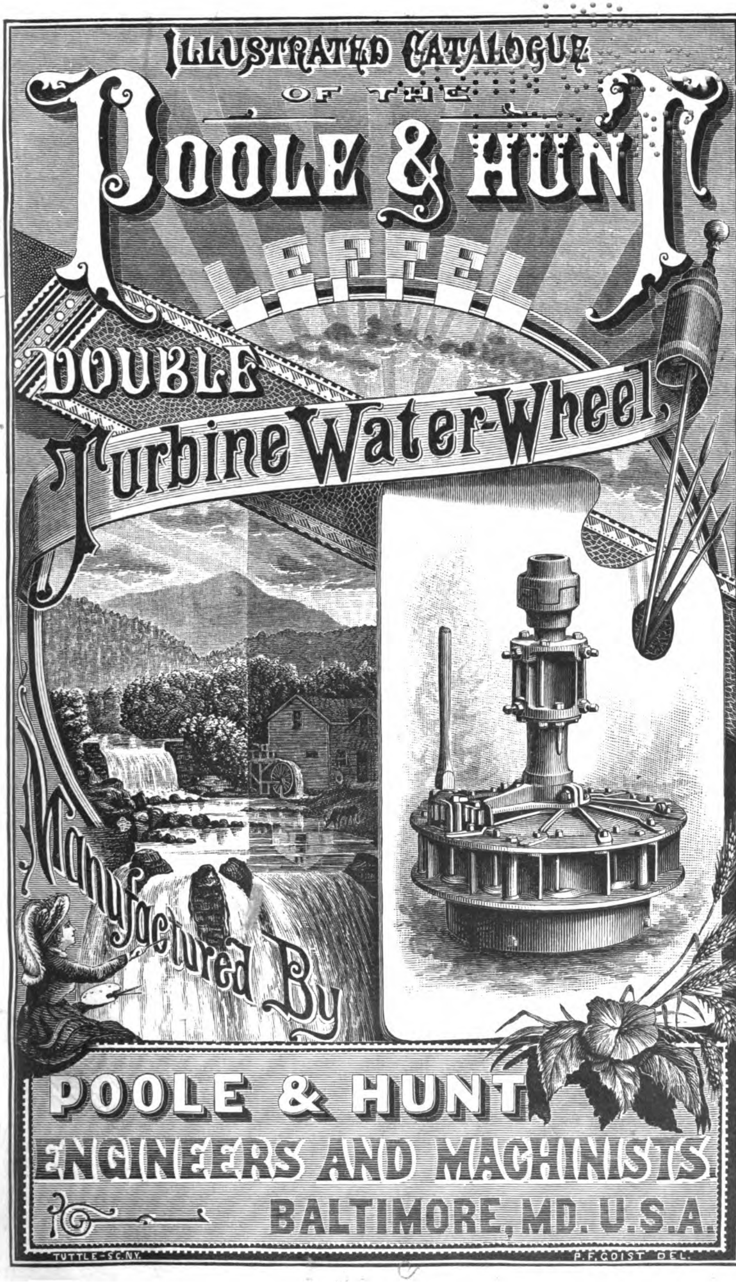
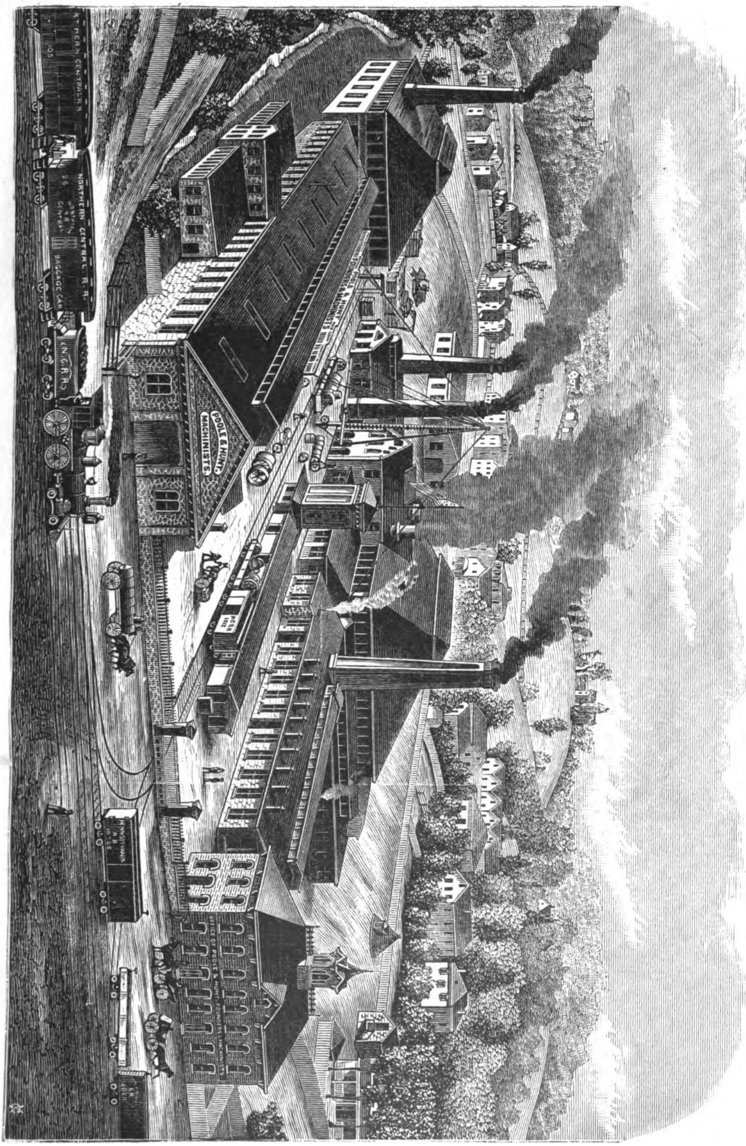

ILLUSTRATED CATALOGUE
OF THE
POOLE & HUNT
LEFFEL
DOUBLE
Turbine Water-Wheel,
Manufactured By
POOLE & HUNT
ENGINEERS AND MACHINISTS.
BALTIMORE, MD. U.S.A.
TUTTLE-SC.NY.
P.F.GOIST DEL.

Electrotyped by
SMITH & McDOUGAL,
N. Y.

Printed by
D. G. F. CLASS,
N. Y.



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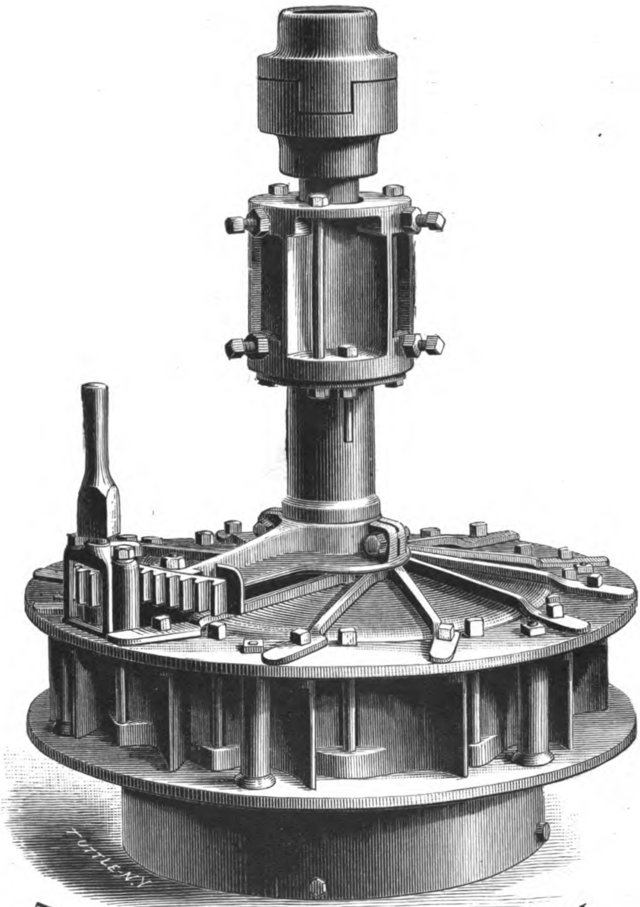
THE POOLE & HUNT LEFFEL



TURBINE WATER-WHEEL.

HAVING been for many years the **manufacturers** of this widely known and justly celebrated turbine, for use in the Southern States, under contract with the late Mr. Leffel, during his lifetime, and now having the right to sell in all the States and Territories, we beg to inform users of water-power, that our facilities for the manufacture of our **Leffel Wheels** are unsurpassed in this country.

We use none but the **best materials,** and our large plant of **special tools** and **machinery** enables us to furnish our wheels at low prices, and in a style of workmanship fully equal to any made in the United States.

We are prepared to meet any possible demand with unusual promptness.

In getting up this New Edition of our Catalogue, we have decided to make it as brief as possible, that readers may not be compelled to wade through a mass of (to them) uninteresting matter, in order to obtain the information they desire to possess.

We have omitted all recommendations or certificates. A book might be filled with them alone, of recent date, but our **Leffel Wheel** is now so well known, that printed certificates are not necessary to advertise its merits.

We submit copious illustrations, showing various applications of our Wheel to a variety of purposes, and feel sure these illustrations will plainly tell their own story, and not suffer when considered as examples of Turbine engineering.

POOLE & HUNT,

BALTIMORE, MD.,

U. S. A.

TO CORRESPONDENTS.

We are constantly in receipt of letters asking about the size of wheel to do a certain amount of work. Some merely say: "I have so many feet head," not a word about the quantity of water; some say: "The stream will furnish so many cubic feet of water per minute," not a word about the head, and some give neither head nor quantity of water; others ask: "What size wheel shall I use to grind so many bushels of corn per hour?" This may appear strange, but it is a fact, hence we are so particular in stating what is required to be known. If attention is given to the article as to ascertaining supply of water, and the questions contained in Special Notice on this page are answered carefully, much time and trouble will be saved, and many disappointments prevented.

SPECIAL NOTICE.

In ordering a wheel, or asking for information, please give the following data:

What is the head of water when at rest; or the vertical distance from surface of head water to surface of tail water?

What quantity of water in cubic feet per minute can be relied on? (Manner of ascertaining this important point is given elsewhere in this pamphlet.)

What kind of machinery do you wish to drive, stating all particulars?

What speed do you wish the machinery to run?

What is the speed of the main line of shafting?

If a corn or wheat mill, state number and size of burrs, and how many bushels of corn or wheat desired to be ground per hour.

If a circular saw, give the diameter of the saw.

If a sash or vertical saw, give the number to be used in gate or sash at one time.

If a woolen or cotton mill, give sets of woolen machinery, or number of spindles and kind of goods made, or power required if known.

Is the wheel to run with or against the sun, or a right or left hand wheel?

If the power is to be taken off **above the level of head water,** give the distance the centre of horizontal power shaft comes **above the level of head water when at rest.**

If the power is to be taken off **below** the level of head water, give the distance of the horizontal power shaft, **below head water** (or above tail water), when at rest.

If you have a pond, give its average length and breadth.

SMALL WHEELS.

There is, as a general thing, great care and attention required in setting up and attaching small wheels to machinery, on account of their high velocity and the great pressure under which they operate.

The essential points to be observed are few and simple, and consist mainly in having the machinery immediately connected to the wheel, of neat proportions, and as light as is consistent with the work to be performed, and otherwise to reduce the friction to the smallest amount, as it must be obvious that massive machinery and much friction upon a small wheel running at a high velocity, must seriously detract from the good performance of the wheel. Simplicity in the arrangement of machinery is likewise of the greatest importance, for it is a very easy matter to so absorb the power of small wheels by undue length of shafting and long train of gearing, particularly bevel gearing, that there will be comparatively little available power left.

By observing the instructions we will give, nothing can exceed the perfect manner in which the small wheels will operate, using the water to the highest degree of economy, running with the utmost regularity and uniformity of motion, and possessing a surpassing durability.

DOUBLE WHEELS.

An idea exists to a considerable extent, that water-wheels may be so constructed, with two or more sets of buckets, in such a manner that each set of buckets may form a separate wheel, and that the water may be received first by one set of buckets, or one wheel, and after passing from the first, then to operate on a second arrangement of buckets, or wheel, and so on with as many sets or wheels as there may be, or until the last one is passed or operated upon; thus in their opinion, obtaining a much greater percentage of the power of water, than is ordinarily utilized by the use of well constructed wheels of other kinds. In fact a much greater power is often claimed for them, than can possibly exist in the quantity of water used. Again, there is another class of wheels claiming to be double wheels, which are in reality, and principle, but single wheels; their builders believing by such representations that the reputation and popularity of our wheel (so celebrated for its truly double character) may thus indirectly benefit them. A single wheel, either a central or vertical discharge wheel, is commonly used, with a partition through the middle of the tier of buckets, thus only dividing the wheel, without in the least changing the action of the water on the buckets on either side of the partition or division, and without any modification of the principle of construction.

Our Leffel Double Turbine should not be confounded with either of these classes of wheels, as it is constructed and acts upon entirely and essentially different principles, which are peculiarly characteristic of it as a water-wheel. There is in it a combination of two independent sets and kinds of buckets, one a vertical, the other a central discharge, each entirely different in its principle of action, yet each wheel or series of buckets receiving its water from the same set of guides at the same time; but the water is acted upon but once, since half of the water admitted by the guides passes to one wheel, and the other half of the water to the other wheel; the water leaving both wheels or sets of buckets at the same time and as quickly as possible. These two sets of buckets are so combined as to make really but one wheel; that is, both are cast in one piece and placed upon the same shaft. By this arrangement there is admitted the greatest possible volume of water, consistent with its economical use, to a wheel of any given size, and at the same time the greatest area for the escape of water is secured. The surface in the wheel is thus reduced to minimum as compared with the quantity of water used, avoiding a very material loss by friction, which otherwise seriously diminishes the working power of a wheel. The value of this arrangement will be fully appreciated by those who understand the practical effect of the frictional surface in a water-wheel.

SPECIAL WHEELS.

We manufacture what we term **special** wheels, from 20 inches to 66 inches diameter inclusive.

The special wheels are wider on the face than the standard wheels, and vent one-third more water, yielding very nearly the same proportional increase in power.

We have made no accurate experiments as to the percentage of power afforded by these special wheels, but their performance has been very satisfactory, and they can be recommended to those who do not desire the greatest possible economy in the use of water.

To those about to select a Water-Wheel.

Do not purchase a **common** water-wheel, because, from its **low price,** it may **seem** to be **cheap.**

It **costs as much money** to erect an **inferior** wheel as it does to put up one of the **most superior quality.**

It is frequently found necessary to **discard an inferior water-wheel,** and **substitute** one of **better quality.** This generally requires a **change of gearing,** and **other alterations,** involving a **large expense** which might have been avoided by choosing the best wheel at first.

The **best** wheel is that which develops the **most power,** from a **given quantity of water,** and which is the **most manageable** and **durable** under use.

The application of the best wheel **adds greatly to the value** of the **water-right.**

The **best** is the **cheapest,** because it does **more work, lasts longer,** and **costs no more to erect** than a common wheel.

Our Leffel Double Turbine Water-Wheel is the **best,** consequently the **cheapest.**

DURABILITY OF OUR LEFFEL-WHEEL.

ITS FREEDOM FROM REPAIRS.

It is a well-known fact among manufacturers that the durability of any machine is truly indicated by the amount of repairs they are required to put upon it.

In almost all manufactories that have been engaged for a term of years in the manufacture of any machine, the repairs on the machines become a large portion of their business. There are some classes of machines, the repairs upon which, after a few years, furnish employment to almost as many workmen as are employed to manufacture the current supply of new machines.

Our Leffel-Wheel has now been manufactured for more than twenty years, and there are thousands running, of various sizes, and yet, what will seem almost incredible, it is a very rare thing indeed that repairs are required for any part of the wheel, from natural wear. The expense is so small, when compared with the large number of our Leffel-Wheels running, as to justify us in saying, that there are few machines that require so little repairs as our Leffel-Wheel.

We have been led to make a statement of this fact, because some wheel-builders, knowing well the success and popularity of our Leffel-Wheel, seek to establish a prejudice against it, by a cry of complication, liable to get out of order, &c., &c. The fact we have just stated, we think conclusive, and should prevent parties being misled by others who seek to give reputation to an inferior wheel, by false statements in regard to our Leffel-Wheel.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MACHINISTS,
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MEASUREMENT OF WATER.

When it is decided to improve a water-power, the first thing is to ascertain the amount of fall; the next and most important thing is to determine accurately the quantity of water that flows in the stream, as upon these will depend the amount of power, and consequently the amount of work the stream is capable of performing. And as the improvement of water-power is necessarily attended with expense, it is important to one who contemplates building a mill or factory that he should know exactly what amount of power he can depend upon the stream affording; and for want of an accurate knowledge, or from erroneous supposition of the quantity of water in the stream, which is too often obtained by a mere superficial examination, parties frequently construct mills and factories of a magnitude which, upon trial, they find the power of the stream wholly inadequate to carry. This being the case, it is important to get some one well versed in hydraulics to measure the capacity of the stream. As this cannot always be done, we give a few plain rules, by the aid of which any one can determine approximately the quantity of water in the stream.

The plate represents a weir or dam across a small stream. Where it is convenient to use a single board as is shown in the cut, select one that is long enough to reach across the stream, resting in the banks at each end; cut a notch in the board sufficient in depth to pass all the water to be measured, and not more than two-thirds the width of the stream in length. The bottom of notch B in the board A should be beveled on the down stream side; the ends of the notch should be also beveled on the same side, and within one-eighth of an inch on the upper side of the board, leaving the edge almost sharp. C is a stake driven in the bottom of the stream several feet above the board or dam, and should be driven down to a level of notch B, this level being easily found as the water is beginning to spill over the board. After the water has come to a stand and reached its greatest depth, a careful measurement can be made of the depth of the water over the top of stake C, as illustrated in the cut by the man with square and measure in his hand, the dotted line E representing the **surface** of water above the stake. Such measurement gives the true depth of water passing over the notch, since, if measured directly on the notch or the board, the curvature of the water in passing would reduce the depth, giving improper data; although where accuracy is not required, such a method will give a fair estimate of the quantity of water. In all cases it is best to make the measurement over the stake. The line D is a level from the bottom of the notch B to the top of stake C; the distance between surface of water and top of stake gives the **true depth** or spill over the weir. The surface of water below the board should not be nearer the notch B than **ten** inches, that the flow of water over the notch may

not be impeded; neither should the nature of the channel above the board be such as to force or hurry water to the board, but it should be of ample width and depth to allow the water to approach the notch and board steadily and quietly. If the water passes the channel rapidly, it will be forced over the notch, and a larger quantity will pass than if allowed to spill from a large body moving slowly.

When the depth of water over the stake C is known, the quantity of water passing can be easily calculated by reference to the Weir table on page 13. This table gives the number of cubic feet of water passing per minute over a weir for each inch in breadth, from one-eighth of an inch in depth to twenty-four and seven-eighths inches depth. The figures 1, 2, 3, &c., in the first and last perpendicular columns, are the inches depth of water over weir, while the first or top horizontal column represents fractional parts of an inch, from one-eighth to seven-eighths. The body of table shows the cubic feet and decimal parts of a cubic foot, that will pass each minute, for each depth of weir from one-eighth to twenty-four and seven-eighths inches as before stated, but each result is for but one inch in width; so for any particular number of inches of breadth of weir, the result obtained in table must be multiplied by the number of inches of breadth the weir may be. For example: suppose the notch or weir to be 20 inches wide, and the water at stake C 5½ inches deep; in the first or last column find the figure 5, follow the horizontal column, until the perpendicular column is reached containing ½ at the top. In the square where these two columns meet will be found 5.18, five and eighteen-hundredths cubic feet; this is the quantity of water that will pass for each inch in width, but since the supposed weir was 20 inches wide, this result must be multiplied by twenty, which gives 103.60; one hundred and three and six-tenths cubic feet per minute. In this manner, the water passing any width of weir, of any depth from one eighth of an inch to twenty-four and seven-eighths inches depth can be easily calculated.

A very important matter in connection with the measurement of small streams, is also the possibility of damming or holding the water, and using it a part of the time instead of constantly. If the above mentioned quantity of water was held for 12 hours, for the remaining twelve hours (if all was used in that time), double the quantity would be available, and consequently double the power obtained for that length of time. The power is thus stored up to be used in less time, besides giving a better effect, since with small quantity of water almost as much power is required to drive the necessary machinery without labor, as when driving it at labor. Now while this whole method may appear simple, we would always like as full an understanding of all the circumstances as possible, however confident parties may be of the accuracy of their measurement.

We therefore particularly request our correspondents in writing on this subject, to give us the depth and width of the water over weir, so we can verify the calculations ourselves; state also what length of time the water can be dammed or held, if the stream is small.

WEIR TABLE,

GIVING CUBIC FEET OF WATER PER MINUTE THAT WILL FLOW OVER A WEIR FOR EACH INCH IN WIDTH, AND FROM 1/8" TO 24 7/8" IN DEPTH.

INCHES.		1/8	1/4	3/8	1/2	5/8	3/4	7/8
		.01	.05	.09	.14	.20	.26	.33
1	.40	.47	.55	.65	.74	.83	.93	1.03
2	1.14	1.14	1.36	1.47	1.59	1.71	1.83	1.96
3	2.09	2.23	2.36	2.50	2.63	2.78	2.92	3.07
4	3.22	3.37	3.52	3.68	3.83	3.99	4.16	4.32
5	3.50	4.67	4.84	5.01	5.18	5.36	5.54	5.72
6	5.60	6.09	6.28	6.47	6.65	6.85	7.05	7.25
7	7.41	7.64	7.84	8.05	8.25	8.45	8.66	8.86
8	9.10	9.31	9.52	9.74	9.96	10.18	10.40	10.62
9	10.86	11.08	11.31	11.54	11.77	12.00	12.23	12.47
10	12.71	12.95	13.19	13.43	13.67	13.93	14.16	14.42
11	14.67	14.92	15.18	15.43	15.67	15.96	16.20	16.46
12	16.73	16.99	17.26	17.52	17.78	18.05	18.32	18.58
13	18.87	19.14	19.42	19.69	19.97	20.24	20.52	20.80
14	21.00	21.37	21.65	21.94	22.22	22.51	22.79	23.08
15	23.38	23.67	23.97	24.26	24.56	24.86	25.16	25.46
16	25.76	26.06	26.36	26.66	26.97	27.27	27.58	27.89
17	28.20	28.51	28.82	29.14	29.45	29.76	30.08	30.39
18	30.70	31.02	31.34	31.66	31.98	32.31	32.63	32.96
19	33.29	33.61	33.94	34.27	34.60	34.94	35.27	35.60
20	35.94	36.27	36.60	36.94	37.28	37.62	37.96	38.31
21	38.65	39.00	39.34	39.69	40.04	40.39	40.73	41.09
22	41.43	41.78	42.13	42.49	42.84	43.20	43.56	43.92
23	44.28	44.64	45.00	45.38	45.71	46.08	46.43	46.81
24	47.18	47.55	47.91	48.28	48.65	49.02	49.39	49.76

MEASUREMENT OF LARGE OPEN STREAMS.

As in many cases it is impossible to construct even a temporary waste-board or weir, the quantity of water that the stream can supply must be obtained by first ascertaining the mean velocity in feet per minute, and also the area of cross-section of the stream in square feet; when the product of these two quantities will give the quantity of water afforded by the stream. The velocity of such streams can be estimated by throwing floating bodies on the surface, of near the same specific gravity as the water, and rating the time accurately required in passing a given distance; it must be borne in mind, however, that the velocity is greatest in the centre of the stream, and near the surface; and that it is less near the bottom and sides. It is generally best to ascertain the velocity at the centre, and from this estimate the mean velocity, which has been found by accurate and reliable experiments to be .83 per cent. or about four-fifths of the velocity of the surface. The cross-section may be estimated by measuring the depth of stream at a number of points, at equal distances apart (these points being in a line across the stream), adding the depths together, and multiplying their sum by the distance apart in feet of any two points. This will give the result required in square feet of cross-section, when the product of mean velocity in feet per minute and cross-section in square feet, obtains the quantity of water that the stream affords in cubic feet per minute.

THE ACTUAL DISCHARGE OF WATER,

AS COMPARED WITH MEASUREMENT OF APERTURES.

A well-constructed Turbine Wheel does not discharge a quantity of water equal to its full measurement of apertures: or, in other words, in order for such a Turbine to discharge a quantity of water equal to that which would flow through an orifice of a certain size under a given fall, and where the discharge is free and unobstructed, the apertures in the wheel must greatly exceed that of the simple orifice. The quantity of water discharged by different Turbines varies according to the construction. The controlling cause of this difference is the varying form—curves and angles—given to the guides and buckets. The actual discharge of our Leffel Wheel is six-tenths of the combined area of its apertures. Suppose we take a wheel in which the total area of the apertures between its guides amounts to 100 square inches; now, this wheel will not discharge a quantity of water equal to 100 square inches, but only equal to 60 square inches. It must be evident to every one that this difference results from the water being retarded in its flow through the guides by coming in contact with the wheel within the casing. To make this clear, let us suppose a wheel, the apertures of whose guides measure 100 square inches, and place it under any given fall. Now, let us suppose we remove the wheel from its casing, and open the guides, the water will then flow freely and unobstructed through the guides into the empty space within the casing: as there is nothing to retard its flow, it will rush through the guides with a velocity due to the head under which it is placed. Now, by placing the wheel again within the casing, it acts as a clog or check to the flow of water, as the water comes in contact with the buckets of the wheel, and instead of passing through the guides with the same velocity as before, it is held back, so that it now passes through the guides with only six-tenths of its former velocity. Consequently, in order that a Turbine should discharge a certain quantity of water, the area of the apertures must greatly exceed that of the aperture that would discharge the same quantity under the same head, when allowed to flow into the open air freely and unretarded. The only reliable and certain means of ascertaining the quantity of water that a Turbine of any established proportions will discharge, is by actual measurement of the water after passing through the wheel. The tables we publish of the quantity of water used by our wheels, are not the result of a mere measurement of their apertures, and a consequent computation by theory, but are the result of numerous and repeated experiments, and actual measurements of water after passing from each wheel; and the quantities, as laid down in our Tables, will be found on trial not to vary in any material amount from the quantity stated.

EXPLANATION OF PLATE No. 3.

Plate No. 3 shows the arrangement of rack in forebay, and figure B represents the best shape to be given to the rack-bars. By making them rounding at the top, the labor of cleaning it is greatly lessened. It is **highly important** that the rack across the race or forebay should be properly put in and attended to ; the bars should be sufficiently apart not to obstruct the flow of water, and should be kept clear of all trash ; many inches of head are lost by this neglect, and often the efficiency of a wheel is impaired by same cause. Proper attention given to this matter will repay well.

It is a good plan, and we would recommend it in all cases, to put in a coarser rack, several feet above the rack shown in cut; the coarse rack will serve to retain the coarser drift, and thus avoid the necessity of frequent removal from the fine rack. The spaces of the coarse rack may be about twice as large as the fine are.

Plate No. 3.

EXPLANATION OF PLATE No. 4.

There are some mills, particularly flouring and saw mills, that are so situated with reference to flume, that it is difficult to pass the wheel-shaft above the surface of the water. This happens where the water (as it frequently is) is on a level with the second or third story of the mill, and the machinery operating on the first floor. In this case the wheel can be put in as shown in the plate. In addition to the ordinary perpendicular portion of flume or penstock, there is a horizontal section of flume built, in which the wheel is placed. The shaft that is attached to wheel-shaft passes out of the top or deck of this section of flume, through a stuffing-box, to prevent leakage of water around the shaft. The power can then be taken off by beveled or spur gears as shown. The advantage of this method of putting in the wheel is, that the power can be brought near to the point where the work is to be done; otherwise it would have to be brought through a long train of gears and shafting, which, of course, would tend much to lessen the effect of the wheel.

As the value of any mill depends mainly upon the power to propel it, we would say, conform the machinery if possible to the wheel, and not the wheel to the machinery, as is too frequently done. Bring the work as near the wheel as possible, and avoid too great length of shafting and complication of gearing.

In building this style of flume, we cannot too much impress the necessity of having strong, heavy timbers and plank, which should also be fitted closely. The gate-rod also passes out of the decking through a stuffing-box.

For size of flume inside, refer to column C, in the table of dimensions.

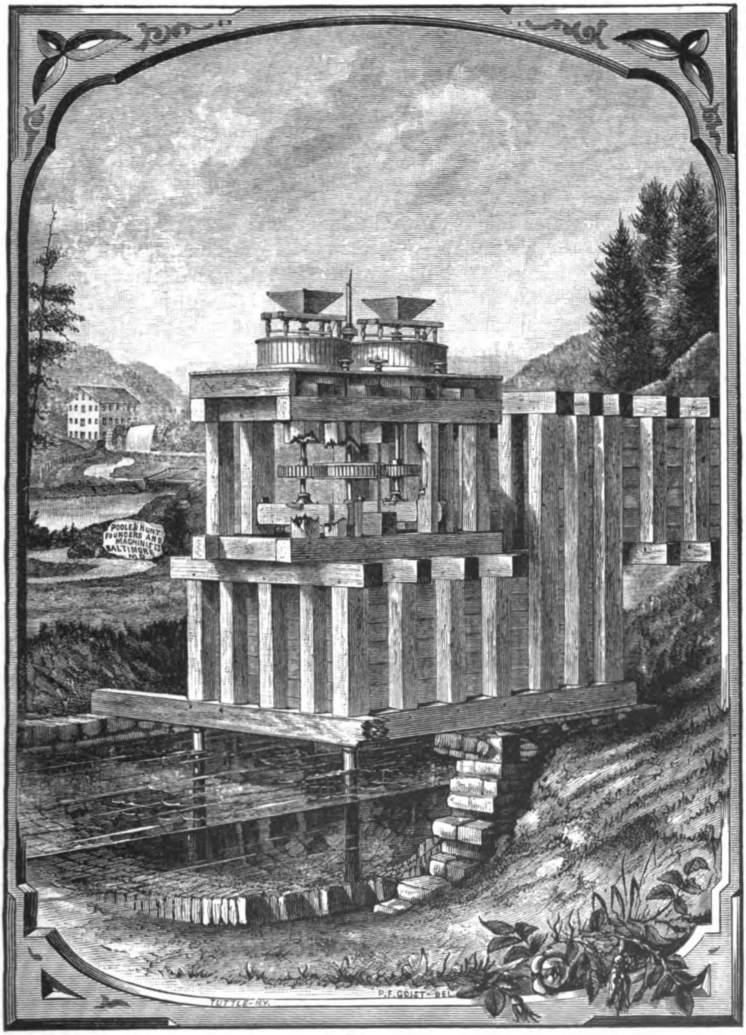
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Plate No. 4.

EXPLANATION OF PLATE No. 5.

Plate No. 5 is intended to show the manner of putting the wheel in under low falls. A plain, substantial flume is constructed, with good, heavy timbers and a firm foundation. There should be sufficient space—depth and width—between the bottom of flume and floor of tail-race, to let the water pass out from beneath the flume without obstruction. The floor of the flume should be of heavy plank, to give sufficient firmness to support the weight of water and wheel. In the floor of the flume there should be a hole cut of a size to admit the cylinder of wheel-casing, which will pass through the flume, the wheel thus resting upon the floor by the flange of the casing. It does not require anything to fix it to its place, as the weight of the water and wheel will hold it firmly in its position. The flume should, in every case, be made according to dimensions given in column C, in table of dimensions, and clearly shown in Plate No. 6. The floor of flume should come near enough to the surface of standing tail-water, so that the end of cylinder of wheel-casing that projects through will dip two inches or more below the surface of the water. A pit of good depth should always be dug underneath the flume, to prevent the water from reacting upon the wheel. No particular style of flume is needed. It can be constructed to suit the peculiarities of the location. The only point to be observed is to have it strong enough and of sufficient capacity to let the water to the wheel without obstruction.

The plate shows the proper form for the pit under the wheel in a rock bottom, as Plate No. 4 shows the form for a pit in an earthen bottom, paved with stone.

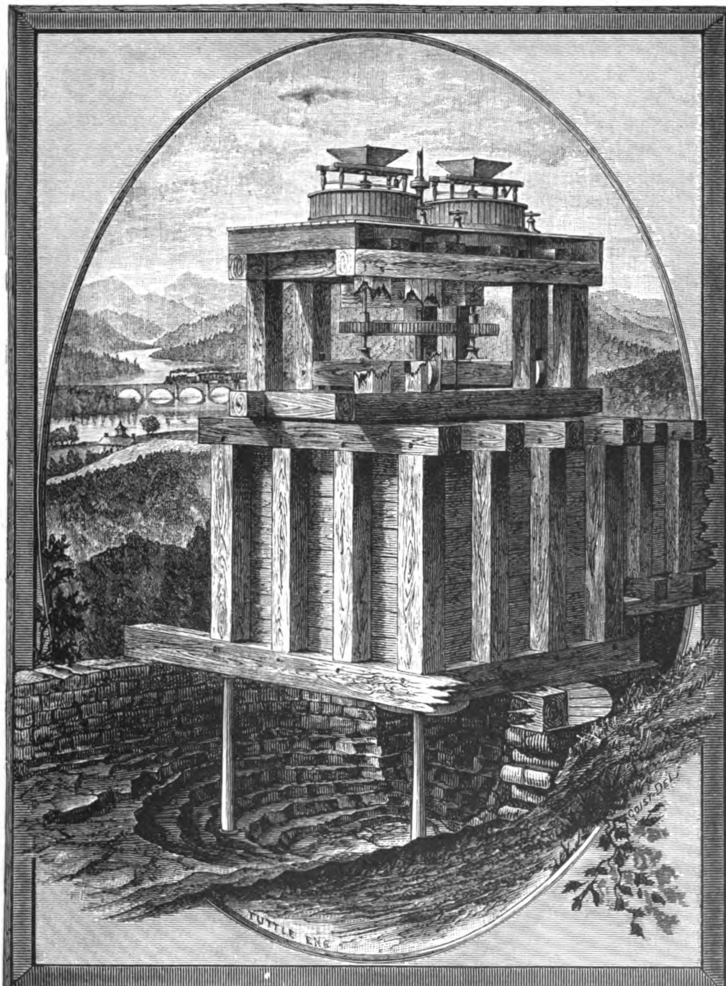


Plate No. 5.

EXPLANATION OF TABLES.

On the following pages will be found tables showing the power, number of revolutions per minute, and also the number of cubic feet of water discharged per minute, for each size of our wheels, under heads from 3 to 40 feet. The top line of figures shows the head and fall in feet. The left hand perpendicular column gives the size of wheels from $7\frac{5}{8}$ (No. 1) to 66 inches diameter. In the small squares formed by the intersection of the perpendicular and horizontal lines will be found three sets of figures. The upper one indicates the number of horse-power; the middle set of figures shows the number of cubic feet of water used by the wheel per minute; the lower set of figures shows the number of revolutions of the wheel per minute.

We will give an example of the manner of determining, by this table, the power, quantity of water used, and revolutions of any sized wheel, under a given fall. Suppose we wanted to find the power of a 20-inch wheel under 11 feet fall: find in the **top** line of figures, indicating the **fall in feet,** the fall required, 11 feet; now follow down the perpendicular column, under the figure 11, until you come to the horizontal column in which the size of the wheel (20-inch wheel) is placed at the left. In the square where these two columns intersect will be found $9\frac{80}{100}$ horse-power; 499 cubic feet of water per minute; 229 revolutions per minute. Again, take a 48-inch wheel under 8 feet fall; in following down the perpendicular column, under figure 8, until you reach the horizontal column leading from the 48-inch wheel to the right, at the intersection will be found $32\frac{99}{100}$ horse-power; 2457 cubic feet of water per minute, and 81 revolutions per minute; which will be the number of horse-power, the cubic feet of water used per minute, and the revolutions per minute, of a wheel 48 inches in diameter under 8 feet fall. The same method will determine the power, quantity of water used per minute, and number of revolutions per minute, of any sized wheel under any fall from 3 to 40 feet.

The revolutions of the wheels, as laid down in this table, are the number of revolutions the wheel makes **when at work.** But as there is always a loss of fall by the water drawing down in the head-race, and also raising in the tail-race, when the wheel is running, we would advise those who have charge of putting the wheels in, that in calculating for the speed of wheel and machinery, they always base their calculations on a fall of from six inches to a foot less than the measured fall, when the head and fall is from 4 to 20 feet, and eighteen inches when the fall is over 20 feet; thus allowing for the loss of head mentioned, which will bring the speed of the wheel to suit the **actual running head.**

TABLE Arranged Specially for the Poole & Hunt Leffel Turbine Water Wheel.

SIZE OF WHEELS		HEAD IN FEET.									
		3	4	5	6	7	8	9	10	11	12
$7\frac{5}{8}$ No. 1.	Horse Power.	.15	.22	.31	.41	.52	.63	.76	.89	1.02	1.17
	Cubic Feet.	29	33	37	41	44	47	50	53	55	58
	Revolutions.	313	362	404	446	478	511	542	592	600	626
$7\frac{5}{8}$	Horse Power.	.20	.30	.42	.56	.70	.86	1.02	1.20	1.38	1.57
	Cubic Feet.	39	45	50	55	60	64	68	71	75	78
	Revolutions.	313	362	404	443	478	511	542	572	600	626
10 No. 1.	Horse Power.	.25	.38	.53	.70	.88	1.08	1.28	1.51	1.74	1.98
	Cubic Feet.	49	57	64	70	75	80	85	90	94	98
	Revolutions.	239	275	308	337	364	390	414	436	457	478
10	Horse Power.	.33	.52	.72	.95	1.18	1.46	1.74	2.04	2.35	2.65
	Cubic Feet.	67	77	86	94	102	109	115	122	128	133
	Revolutions.	239	275	308	337	364	390	414	436	457	478
$13\frac{1}{4}$ No. 1.	Horse Power.	.44	.67	.94	1.24	1 56	1.90	2.27	2.66	3.07	3.50
	Cubic Feet.	87	100	112	123	133	142	150	159	166	174
	Revolutions.	180	208	233	255	275	294	312	329	345	360
$13\frac{1}{4}$	Horse Power.	.58	.90	1.25	1 65	2.08	2.54	3.03	3.55	4.09	4.66
	Cubic Feet.	116	134	149	164	177	189	201	211	222	232
	Revolutions.	180	208	233	255	275	294	312	329	345	360
$15\frac{1}{4}$	Horse Power.	.76	1.17	1.63	2.14	2.70	3.30	3.94	4.61	5.32	6.06
	Cubic Feet.	151	174	194	213	230	246	261	275	288	301
	Revolutions.	157	181	202	221	239	256	271	286	300	313
$17\frac{1}{2}$	Horse Power.	.97	1.53	2.13	2.80	3.53	4.31	5.15	6.03	6 96	7.93
	Cubic Feet.	197	227	254	278	301	321	341	359	377	393
	Revolutions.	136	158	176	193	208	223	236	249	261	273
20	Horse Power.	1.31	2.02	2.82	3.71	4.67	5.71	6.81	7.98	9.20	10.49
	Cubic Feet.	260	301	336	368	398	425	451	476	499	521
	Revolutions.	119	138	154	169	182	195	207	218	229	239
23	Horse Power.	1.75	2.69	3.76	4.94	6.23	7.61	9.08	10.64	12.28	13.99
	Cubic Feet.	347	401	443	491	531	567	602	634	665	695
	Revolutions.	104	119	134	147	159	169	180	190	199	208
$26\frac{1}{2}$	Horse Power.	2.27	3.50	4.89	6.43	8.10	9.90	11.81	13.83	15.96	18.18
	Cubic Feet.	451	521	583	638	690	737	782	824	864	903
	Revolutions.	90	104	116	127	138	147	156	164	173	180
$30\frac{1}{2}$	Horse Power.	3.03	4.67	6.52	8.57	10.80	13.20	15.75	18.44	21.28	24.24
	Cubic Feet.	602	695	777	851	920	983	1043	1099	1153	1204
	Revolutions.	78	90	101	111	120	128	136	143	150	157
35	Horse Power.	3.99	6 15	8.59	11.29	14.23	17.38	20.74	24.30	28.03	31.94
	Cubic Feet.	793	916	1023	1121	1211	1295	1373	1443	1518	1586
	Revolutions.	68	79	88	96	104	111	118	125	131	136
40	Horse Power.	5.25	8.08	11.23	14.83	18.79	22.84	27.26	31.92	36.83	41.96
	Cubic Feet.	1042	1203	1345	1473	1592	1701	1804	1902	1995	2083
	Revolutions.	60	69	77	84	91	97	103	109	114	119
44	Horse Power.	5.9	9.4	13.1	17.2	21.9	26.6	31.8	37.2	45.0	49.3
	Cubic Feet.	1213	1400	1568	1717	1857	1978	2110	2211	2324	2426
	Revolutions.	55	63	70	77	83	89	94	100	104	109
48	Horse Power.	7.58	11.66	16.30	21.42	27.00	32.99	39.37	46.11	53.20	60.61
	Cubic Feet.	1505	1738	1942	2128	2299	2457	2607	2747	2882	3009
	Revolutions.	50	57	64	70	76	81	86	91	95	99
52	Horse Power.	9.85	15.16	21.19	27.85	35.10	42.89	51.18	59.94	69.16	78.79
	Cubic Feet.	1956	2259	2525	2766	2989	3194	3389	3571	3746	3912
	Revolutions.	44	53	60	65	70	76	80	86	90	94
56	Horse Power.	13.10	19.77	27.65	36.32	45.78	55.93	66.75	78.17	90.21	102.75
	Cubic Feet.	2556	2931	3273	3587	3875	4143	4457	4646	4857	5075
	Revolutions.	42	49	55	60	65	69	74	78	82	85
61	Horse Power.	15.16	23.32	32.60	42.84	54.00	65.98	78.74	92.22	106.40	121.22
	Cubic Feet.	3010	3416	3884	4256	4598	4914	5214	5494	5764	6018
	Revolutions.	40	45	50	55	60	64	68	71	75	78
66	Horse Power.	19.21	29.55	41.28	54.28	67.82	81.00	98.00	116.00	133.00	152.00
	Cubic Feet.	3750	4330	4840	5302	5729	6123	6496	6847	7182	7500
	Revolutions.	35	40	45	50	54	57	61	64	67	70

TABLE Arranged Specially for the Poole & Hunt Leffel Turbine Water Wheel.

SIZE OF WHEELS		HEAD IN FEET. 13	14	15	16	17	18	19	20	21	22
7 5/8 No. 1.	Horse Power.	1.31	1.47	1.63	1.79	1.97	2.14	2.32	2.51	2.70	2.89
	Cubic Feet.	60	63	65	67	69	71	73	75	77	78
	Revolutions.	652	677	700	723	745	767	788	809	828	847
7 5/8	Horse Power.	1.77	1.98	2.20	2.42	2.65	2.89	3.14	3.39	3.64	3.91
	Cubic Feet.	81	84	87	90	93	96	98	101	103	106
	Revolutions.	652	677	700	723	745	767	788	809	828	847
10 No. 1.	Horse Power.	2.23	2.50	2.76	3.05	3.34	3.64	3.95	4.26	4.59	4.93
	Cubic Feet.	102	106	110	114	117	121	124	127	130	133
	Revolutions.	497	516	534	551	568	585	601	617	632	647
10	Horse Power.	3.02	3.38	3.75	4.13	4.52	4.93	5.34	5.77	6.21	6.65
	Cubic Feet.	139	144	149	154	159	163	168	172	176	180
	Revolutions.	497	516	534	551	568	585	601	617	632	647
13 1/4 No. 1.	Horse Power.	3.94	4.41	4.89	5.38	5.90	6.43	6.97	7.53	8.10	8.68
	Cubic Feet.	181	188	194	201	207	213	219	224	230	235
	Revolutions.	375	389	403	416	429	441	454	465	477	488
13 1/4	Horse Power.	5.26	5.88	6.52	7 18	7.86	8.57	9.29	10.03	10.79	11.57
	Cubic Feet.	241	250	259	267	276	284	291	299	306	313
	Revolutions.	375	389	403	416	429	441	454	465	477	488
15 1/4	Horse Power.	6.83	7.64	8.47	9.33	10.22	11.14	12.08	13.04	14.03	15.04
	Cubic Feet.	313	325	337	348	358	369	379	389	398	407
	Revolutions.	326	338	350	362	373	384	394	404	414	424
17 1/2	Horse Power.	8.94	9.99	11.08	12.20	13.37	14.56	15.79	17.06	18.35	19.67
	Cubic Feet.	410	425	440	455	469	482	495	508	521	533
	Revolutions.	284	295	305	315	325	334	343	352	361	369
20	Horse Power.	11.83	13.22	14.66	16.15	17.69	19.28	20.90	22.58	24.29	26.04
	Cubic Feet.	542	563	582	602	620	638	656	673	689	705
	Revolutions.	249	258	267	276	284	293	300	308	316	323
23	Horse Power.	15.77	17.63	19.55	21.54	23.59	25.70	27.87	30.10	32.38	34.72
	Cubic Feet.	723	750	777	802	827	851	874	897	919	940
	Revolutions.	216	224	232	240	247	254	261	268	275	281
26 1/2	Horse Power.	20.50	22.92	25.41	28.00	30.65	33.41	36.23	39.13	42.10	45.13
	Cubic Feet.	940	975	1009	1043	1075	1106	1136	1166	1194	1223
	Revolutions.	188	195	201	208	214	221	227	233	238	244
30 1/2	Horse Power.	27.33	30.56	33.88	37.33	40.89	44.45	48.31	52.17	56.13	60.18
	Cubic Feet.	1253	1300	1346	1390	1433	1475	1515	1554	1592	1630
	Revolutions.	163	169	175	181	187	192	197	202	207	212
35	Horse Power.	36.01	40.25	44.64	49.17	53.86	58.68	63.64	68.73	73.94	79.27
	Cubic Feet.	1650	1713	1773	1831	1888	1943	1996	2048	2098	2147
	Revolutions.	142	148	153	158	162	167	172	176	180	185
40	Horse Power.	47.31	52.88	58.64	64.61	70.76	77.10	83.61	90.34	97.14	104.15
	Cubic Feet.	2168	2251	2330	2406	2480	2552	2622	2690	2756	2821
	Revolutions.	124	129	133	138	142	146	150	154	158	162
44	Horse Power.	55.1	61.6	68.4	75.3	82.6	89.8	97.5	10.63	115.3	125.2
	Cubic Feet.	2529	2622	2716	2209	2893	2977	3051	3136	3214	3393
	Revolutions.	114	118	122	126	130	134	137	141	145	148
48	Horse Power.	68.33	76.39	84.71	93.32	102.21	111.37	120.77	130.43	140.32	150.44
	Cubic Feet.	3132	3251	3365	3475	3583	3687	3787	3885	3981	4075
	Revolutions.	104	107	111	115	118	122	125	128	132	135
52	Horse Power.	88.88	99.81	110.12	121.32	132.86	144.78	157.00	169.56	182.42	195.57
	Cubic Feet.	4072	4226	4374	4518	4658	4793	4923	5051	5175	5297
	Revolutions.	99	102	106	110	112	115	116	119	122	125
56	Horse Power.	115.83	129.50	143.65	158.28	173.27	188.80	209.73	221.18	237.88	255.10
	Cubic Feet.	5282	5481	5673	5853	6041	6220	6387	6553	6713	6851
	Revolutions.	89	92	97	99	101	104	107	110	112	116
61	Horse Power.	136.66	152.78	169.42	186.64	204.42	222.74	241.54	260.86	280.64	300.88
	Cubic Feet.	6264	6502	6730	6950	7166	7374	7574	7770	7962	8148
	Revolutions.	81	84	86	90	93	96	98	101	103	106
66	Horse Power.	172.00	192.00	214.00	236.00	258.00	282.00	305.00	330.00	355.00	381.00
	Cubic Feet.	7805	8102	8385	8661	8928	9188	9439	9684	9922	10154
	Revolutions.	73	76	79	81	84	86	89	91	93	95

TABLE Arranged Specially for the Poole & Hunt Leffel Turbine Water Wheel.

SIZE OF WHEELS		HEAD IN FEET.								
		23	24	25	26	27	28	29	30	31
7 5/8 No. 1.	Horse Power.	3.09	3.30	3.51	3.72	3.93	4.15	4.38	4.61	4.84
	Cubic Feet.	80	82	84	85	87	88	90	92	93
	Revolutions.	867	886	904	922	939	956	973	990	1007
7 5/8	Horse Power.	4.18	4.45	4.73	5.02	5.31	5.61	5.91	6.22	6.53
	Cubic Feet.	108	111	113	115	117	119	121	124	126
	Revolutions.	867	886	904	922	939	956	973	990	1007
10 No. 1.	Horse Power.	5.26	5.60	5.96	6.23	6.69	7.06	7.44	7.83	8.23
	Cubic Feet.	136	139	142	144	148	150	153	156	158
	Revolutions.	661	675	689	703	716	729	742	755	767
10	Horse Power.	7.12	7.58	8.06	8.55	9.05	9.55	10.07	10.60	11.18
	Cubic Feet.	184	188	192	196	200	203	207	211	214
	Revolutions.	661	675	689	703	716	729	742	755	767
13 1/4 No. 1.	Horse Power.	9.28	9.89	10.51	11.15	11.80	12.46	13.14	13.82	14.52
	Cubic Feet.	241	246	251	256	260	265	270	275	279
	Revolutions.	499	510	520	530	540	550	560	570	579
13 1/4	Horse Power.	12.37	13.19	14.02	14.87	15.74	16.62	17.51	18.43	19.36
	Cubic Feet.	321	327	334	341	347	354	360	366	372
	Revolutions.	499	510	520	530	540	550	560	570	579
15 1/4	Horse Power.	16.08	17.14	18.23	19.33	20.46	21.60	22.77	23.96	25.17
	Cubic Feet.	417	426	434	443	451	460	468	476	484
	Revolutions.	433	443	452	461	470	478	487	495	503
17 1/2	Horse Power.	21.08	22.42	23.84	25.28	26.75	28.25	29.77	31.33	32.91
	Cubic Feet.	545	557	568	579	590	602	612	622	633
	Revolutions.	378	386	394	402	409	417	424	431	439
20	Horse Power.	27.83	29.67	31.54	33.46	35.41	37.39	39.41	41.47	43.55
	Cubic Feet.	721	737	752	767	781	796	810	824	837
	Revolutions.	331	338	345	351	358	365	371	378	384
23	Horse Power.	37.12	39.56	42.05	44.61	47.21	49.85	52.54	55.30	58.08
	Cubic Feet.	962	982	1003	1022	1042	1061	1079	1098	1117
	Revolutions.	287	294	300	306	311	317	323	328	334
26 1/2	Horse Power.	48.25	51.43	54.68	57.99	61.37	64.80	68.30	71.89	75.50
	Cubic Feet.	1250	1277	1303	1329	1354	1379	1403	1428	1451
	Revolutions.	249	255	260	265	270	275	280	285	290
30 1/2	Horse Power.	64.33	68.58	72.91	77.32	81.82	86.40	91.07	95.85	100.69
	Cubic Feet.	1667	1703	1738	1772	1806	1838	1871	1904	1935
	Revolutions.	217	221	226	230	235	239	243	248	252
35	Horse Power.	84.75	90.34	96.04	101.84	107.78	113.82	119.97	126.26	132.60
	Cubic Feet.	2195	2243	2289	2334	2379	2422	2465	2508	2549
	Revolutions.	189	193	197	201	205	208	212	216	219
40	Horse Power.	111.33	118.69	126.19	133.82	141.62	149.54	157.62	165.89	174.23
	Cubic Feet.	2884	2947	3007	3067	3125	3182	3238	3295	3349
	Revolutions.	165	169	172	176	179	182	186	189	192
44	Horse Power.	133.9	142.7	151.7	160.9	170.3	179.8	189.5	199.5	209.6
	Cubic Feet.	3470	3545	3618	3688	3760	3826	3890	3964	4025
	Revolutions.	151	155	158	161	164	167	170	173	176
48	Horse Power.	160.83	171.44	182.27	193.30	204.56	216.00	227.67	239.62	251.66
	Cubic Feet.	4166	4256	4344	4430	4514	4597	4678	4759	4837
	Revolutions.	138	141	144	146	149	152	155	157	160
52	Horse Power.	209.08	222.87	236.95	251.30	265.93	280.80	295.72	311.51	327.16
	Cubic Feet.	5416	5533	5647	5759	5868	5976	6081	6187	6288
	Revolutions.	128	131	134	136	138	139	142	145	147
56	Horse Power.	272.63	290.58	309.15	330.23	346.85	366.13	386.01	406.30	427.90
	Cubic Feet.	7053	7185	7325	7468	7612	7749	7887	8025	8157
	Revolutions.	118	121	123	126	128	130	132	135	137
61	Horse Power.	321.66	342.88	364.54	386.60	408.12	432.00	455.34	479.24	503.32
	Cubic Feet.	8332	8512	8688	8860	9028	9194	9356	9518	9674
	Revolutions.	108	110	113	115	117	119	121	124	126
66	Horse Power.	407.00	433.00	461.00	488.00	517.00	546.00	576.00	606.00	637.00
	Cubic Feet.	10384	10595	10326	11040	11250	11455	11658	11860	12055
	Revolutions.	97	99	101	103	105	107	109	111	113

TABLE Arranged Specially for the Poole & Hunt Leffel Turbine Water Wheel.

SIZE OF WHEELS		HEAD IN FEET.								
		32	33	34	35	36	37	38	39	40
7 5/8 No. 1.	Horse Power.	5.08	5.32	5.56	5.81	6.06	6.31	6.57	6.84	7.09
	Cubic Feet.	95	96	97	99	100	102	103	104	106
	Revolutions.	1024	1039	1054	1070	1085	1100	1115	1129	1143
7 5/8	Horse Power.	6.85	7.18	7.50	7.84	8.18	8.52	8.87	9.22	9.58
	Cubic Feet.	128	130	132	134	136	137	139	141	143
	Revolutions.	1024	1039	1054	1070	1085	1100	1115	1129	1143
10 No. 1.	Horse Power.	8.63	9.04	9.45	9.87	10.30	10.73	11.17	11.61	12.06
	Cubic Feet.	161	163	166	168	171	173	175	177	180
	Revolutions.	780	792	804	816	827	838	850	861	872
10	Horse Power.	11.68	12.23	12.79	13.36	13.93	14.51	15.11	15.71	16.32
	Cubic Feet.	217	221	224	227	231	234	237	240	243
	Revolutions.	780	792	804	816	827	838	850	861	872
13 1/4 No. 1.	Horse Power.	15.23	15.95	16.68	17.42	18.17	18.93	19.71	20.49	21.28
	Cubic Feet.	284	288	292	297	301	305	309	313	317
	Revolutions.	589	598	607	616	624	633	641	650	658
13 1/4	Horse Power.	20.31	21.26	22.24	23.23	24.23	25.24	26.28	27.32	28.37
	Cubic Feet.	378	384	390	396	401	407	412	417	423
	Revolutions.	589	598	607	616	624	633	641	650	658
15 1/4	Horse Power.	26.40	27.64	28.91	30.20	31.50	32.82	34.16	35.51	36.89
	Cubic Feet.	492	499	507	514	521	528	536	543	550
	Revolutions.	511	519	527	535	542	550	557	564	572
17 1/2	Horse Power.	34.52	36.15	37.81	39.50	41.19	42.91	44.67	46.44	48.24
	Cubic Feet.	643	653	663	672	682	691	700	710	719
	Revolutions.	446	453	459	466	473	479	486	492	498
20	Horse Power.	45.69	47.84	50.04	52.27	54.51	56.80	59.12	61.46	63.84
	Cubic Feet.	851	864	877	890	902	915	927	939	951
	Revolutions.	390	396	402	408	414	419	425	430	436
23	Horse Power.	60.92	63.79	66.72	69.70	72.68	75.73	78.83	81.95	85.12
	Cubic Feet.	1134	1152	1169	1186	1203	1220	1236	1252	1268
	Revolutions.	339	344	350	355	360	365	369	374	379
26 1/2	Horse Power.	79.19	82.93	86.76	90.61	94.49	98.45	102.47	106.53	110.66
	Cubic Feet.	1475	1497	1520	1542	1564	1585	1607	1628	1648
	Revolutions.	294	299	303	308	312	316	321	325	329
30 1/2	Horse Power.	105.58	110.57	115.65	120.81	125.98	131.26	136.63	142.04	147.53
	Cubic Feet.	1966	1996	2027	2057	2085	2114	2142	2170	2198
	Revolutions.	256	260	264	268	271	275	279	282	286
35	Horse Power.	139.09	145.65	152.34	159.14	165.96	172.91	179.99	187.11	194.36
	Cubic Feet.	2590	2630	2670	2709	2747	2785	2822	2859	2895
	Revolutions.	223	226	230	233	236	240	243	246	249
40	Horse Power.	182.75	191.37	200.16	209.09	218.05	227.18	236.48	245.83	255.37
	Cubic Feet.	3403	3455	3508	3560	3609	3658	3708	3756	3804
	Revolutions.	195	198	201	204	207	210	212	215	218
44	Horse Power.	219.7	230.1	240.7	251.4	262.2	273.2	284.4	295.6	307.1
	Cubic Feet.	4098	4155	4224	4282	4341	4401	4459	4517	4576
	Revolutions.	178	181	184	187	189	192	194	197	200
48	Horse Power.	263.97	276.42	289.14	302.02	314.95	328.15	341.58	355.11	368.87
	Cubic Feet.	4915	4991	5067	5142	5213	5286	5356	5425	5495
	Revolutions.	162	165	167	170	172	175	177	179	182
52	Horse Power.	343.16	359.35	375.90	392.63	409.44	426.60	444.05	461.64	479.63
	Cubic Feet.	6390	6488	6587	6684	6777	6871	6963	7058	7143
	Revolutions.	150	153	155	158	160	162	165	167	170
56	Horse Power.	440.05	469.16	490.25	512.73	537.90	550.65	580.26	612.31	629.68
	Cubic Feet.	8330	8412	8593	8731	8818	8951	9075	9193	9230
	Revolutions.	139	142	144	147	149	150	153	155	157
61	Horse Power.	527.94	552.84	578.28	604.04	629.90	656.30	683.16	710.22	737.74
	Cubic Feet.	9830	9982	10134	10284	10426	10572	10712	10850	10990
	Revolutions.	128	130	132	134	136	137	139	141	143
66	Horse Power.	668.00	700.00	732.00	765.00	797.00	831.00	865.00	900.00	933.00
	Cubic Feet.	12250	12438	12627	12814	12992	13170	13348	13521	13694
	Revolutions.	115	117	119	120	122	124	125	127	129

TABLE Arranged Specially for the Poole & Hunt Leffel Turbine Water Wheel.

SIZE OF WHEELS		HEAD IN FEET.									
		41	42	43	44	45	46	47	48	49	50
7⅝	Horse Power.	7.2	7.4	7.8	8.0	8.3	8.5	8.9	9.2	9.5	9.8
	Cubic Feet.	108	109	110	112	113	114	115	116	117	119
No. 1.	Revolutions.	1158	1168	1178	1200	1212	1225	1237	1252	1265	1277
7⅝	Horse Power.	9.8	10.0	10.2	10.6	10.9	11.0	11.4	12.0	12.2	12.4
	Cubic Feet.	145	146	148	150	152	153	155	156	157	159
	Revolutions.	1158	1168	1178	1200	1212	1225	1237	1252	1265	1277
10	Horse Power.	12.5	13.0	13.4	14.0	14.4	15.0	15.6	16.1	16.5	17.0
	Cubic Feet.	182	184	186	188	190	191	193	196	198	200
No. 1.	Revolutions.	882	893	903	914	924	934	945	956	965	974
10	Horse Power.	17.0	17.6	17.9	18.2	18.5	19.0	19.5	20.4	21.0	21.6
	Cubic Feet.	246	249	253	256	258	261	264	266	269	272
	Revolutions.	882	893	903	914	924	934	945	956	965	974
13¼	Horse Power.	22.0	22.8	23.7	24.0	24.8	25.6	26.4	27.3	28.0	28.9
	Cubic Feet.	321	324	328	332	336	340	344	348	352	356
No. 1.	Revolutions.	665	674	682	690	698	706	714	720	727	735
13¼	Horse Power.	29.0	30.3	31.0	32.0	33.5	35.6	36.4	38.0	39.1	40.3
	Cubic Feet.	428	433	438	444	449	454	460	464	469	474
	Revolutions.	665	674	682	690	698	706	714	720	727	735
15¼	Horse Power.	37.9	39.0	40.5	42.0	43.6	45.0	47.1	48.6	50.0	52.1
	Cubic Feet.	556	562	569	576	584	591	596	602	609	616
	Revolutions.	579	586	593	600	606	613	620	626	633	640
17½	Horse Power.	50.0	52.0	54.6	56.0	57.6	60.0	62.4	64.4	66.0	68.1
	Cubic Feet.	728	736	744	752	758	764	772	782	792	800
	Revolutions.	504	510	516	523	529	535	541	546	552	558
20	Horse Power.	68.6	70.4	71.6	72.8	74.0	76.1	78.1	81.4	84.0	86.4
	Cubic Feet.	984	997	1012	1024	1032	1044	1056	1064	1076	1088
	Revolutions.	441	446	451	457	462	467	472	478	482	487

TABLE Arranged Specially for the Poole & Hunt Leffel Turbine Water Wheel.

SIZE OF WHEELS		HEAD IN FEET.									
		51	52	53	54	55	56	57	58	59	60
7⅝	Horse Power.	10.1	10.4	10.7	11.0	11.3	11.6	11.9	12.2	12.5	12.8
	Cubic Feet.	120	121	122	123	125	126	127	128	129	139
No. 1.	Revolutions.	1289	1304	1317	1328	1342	1354	1366	1378	1390	1400
7⅝	Horse Power.	12.8	13.3	13.7	14.0	14.5	15.0	15.4	16.0	16.6	17.0
	Cubic Feet.	161	162	164	165	167	168	170	172	173	174
	Revolutions.	1289	1304	1317	1328	1342	1354	1366	1378	1390	1400
10	Horse Power.	17.5	18.0	18.5	19.0	19.6	20.0	20.6	21.0	21.5	22.1
	Cubic Feet.	203	204	206	208	210	212	213	216	218	220
No. 1.	Revolutions.	983	994	1003	1012	1021	1032	1041	1050	1059	1068
10	Horse Power.	22.0	22.8	23.6	24.5	25.4	26.0	26.8	27.6	28.4	29.0
	Cubic Feet.	275	278	280	283	286	288	291	293	296	298
	Revolutions.	983	994	1003	1012	1021	1032	1041	1050	1059	1068
13¼	Horse Power.	29.7	31.6	32.1	33.6	34.0	34.6	35.5	36.4	37.0	38.0
	Cubic Feet.	360	363	366	371	375	378	382	386	390	391
No. 1.	Revolutions.	743	750	757	764	771	778	785	792	799	806
13¼	Horse Power.	40.9	41.5	42.6	43.6	44.8	46.0	47.4	48.7	50.1	51.3
	Cubic Feet.	478	482	487	491	495	500	504	509	513	518
	Revolutions.	743	750	757	764	771	778	785	792	799	806
15¼	Horse Power.	54.3	55.2	56.4	58.0	59.5	61.3	62.8	64.0	66.0	68.0
	Cubic Feet.	622	626	632	638	644	650	656	662	669	674
	Revolutions.	646	652	658	664	670	676	682	688	694	700
17½	Horse Power.	70.0	72.2	74.0	76.2	78.4	80.2	82.4	84.2	86.0	88.3
	Cubic Feet.	812	816	824	832	840	848	852	860	870	880
	Revolutions.	564	568	573	578	583	589	597	602	606	610
20	Horse Power.	88.1	91.2	94.4	98.0	101.6	104.0	107.2	110.4	113.6	116.0
	Cubic Feet.	1100	1112	1122	1132	1142	1152	1163	1172	1188	1192
	Revolutions.	491	497	501	506	510	516	520	525	529	534

TABLE Arranged Specially for the Poole & Hunt Leffel Turbine Water Wheel.

SIZE OF WHEELS		HEAD IN FEET.									
		61	62	63	64	65	66	67	68	69	70
7⅝ No. 1.	Horse Power.	13.0	13.3	13.6	14.0	14.2	14.6	14.7	15.0	15.4	15.9
	Cubic Feet.	131	132	133	134	135	136	137	138	139	140
	Revolutions.	1412	1423	1435	1449	1456	1465	1478	1490	1500	1511
7⅝	Horse Power.	17.3	17.8	18.2	18.5	19.0	19.4	19.8	20.2	20.4	20.7
	Cubic Feet.	176	177	179	180	182	184	185	186	188	189
	Revolutions.	1412	1423	1435	1449	1456	1465	1478	1490	1500	1511
10 No. 1.	Horse Power.	22.5	23.1	23.6	24.5	25.3	26.0	26.6	27.0	27.4	28.0
	Cubic Feet.	221	223	226	228	230	232	233	234	236	237
	Revolutions.	1077	1086	1095	1102	1110	1118	1127	1136	1144	1152
10	Horse Power.	29.8	30.6	31.6	32.0	33.8	34.6	35.0	35.5	36.0	36.7
	Cubic Feet.	300	303	306	308	311	314	316	318	321	323
	Revolutions.	1077	1086	1095	1102	1110	1118	1127	1136	1144	1152
13¼ No. 1.	Horse Power.	38.9	40.0	41.0	42.3	43.2	44.4	45.0	46.3	47.0	48.5
	Cubic Feet.	393	396	399	402	405	408	411	414	417	420
	Revolutions.	813	819	826	832	838	845	851	858	864	870
13¼	Horse Power.	52.5	53.2	55.0	56.4	57.6	58.9	60.0	62.1	63.9	65.0
	Cubic Feet.	523	528	533	535	538	543	547	552	556	561
	Revolutions.	813	819	826	832	828	845	851	858	864	870
15¼	Horse Power.	69.8	71.5	73.2	75.0	77.0	79.1	81.2	82.2	83.8	85.0
	Cubic Feet.	680	687	693	696	700	706	711	716	720	725
	Revolutions.	706	712	718	724	730	735	740	746	751	757
17½	Horse Power.	90.0	92.2	94.3	97.7	101.0	104.2	106.5	108.0	109.7	112.0
	Cubic Feet.	885	892	902	912	921	929	933	936	942	948
	Revolutions.	615	620	625	630	635	640	645	650	655	659
20	Horse Power.	119.2	122.4	126.2	129.3	135.0	138.4	140.8	142.2	144.8	146.8
	Cubic Feet.	1201	1212	1224	1235	1244	1255	1264	1273	1283	1292
	Revolutions.	538	543	548	551	555	559	563	568	572	576

TABLE Arranged Specially for the Poole & Hunt Leffel Turbine Water Wheel.

SIZE OF WHEELS		HEAD IN FEET.									
		71	72	73	74	75	76	77	78	79	80
7⅝ No. 1.	Horse Power.	16.3	16.5	16.8	17.0	17.5	18.0	18.4	18.7	19.0	19.5
	Cubic Feet.	141	142	143	144	145	146	147	148	149	150
	Revolutions.	1523	1534	1545	1556	1566	1576	1586	1597	1608	1618
7⅝	Horse Power	21.3	22.0	22.5	22.8	23.5	24.0	24.5	25.0	25.5	26.0
	Cubic Feet.	190	192	193	194	195	196	198	199	200	202
	Revolutions.	1523	1534	1545	1556	1566	1576	1586	1597	1608	1618
10 No. 1.	Horse Power.	28.5	29.0	29.6	30.8	31.4	32.0	32.5	33.0	33.6	34.0
	Cubic Feet.	239	242	244	245	246	248	250	252	253	254
	Revolutions.	1160	1170	1178	1186	1194	1202	1211	1218	1226	1234
10	Horse Power.	37.6	38.2	39.0	40.8	41.0	41.6	42.4	43.0	44.0	45.0
	Cubic Feet.	325	326	328	331	334	336	338	340	342	344
	Revolutions.	1160	1170	1178	1186	1194	1202	1211	1218	1226	1234
13¼ No. 1.	Horse Power.	49.6	50.5	51.6	52.7	54.6	55.0	56.0	57.0	58.1	59.0
	Cubic Feet.	423	426	429	432	435	438	440	443	445	448
	Revolutions.	876	882	888	895	902	908	914	920	926	930
13¼	Horse Power.	66.1	67.3	68.5	70.0	72.4	73.2	74.8	76.0	77.4	79.1
	Cubic Feet.	565	570	574	577	579	582	585	588	593	596
	Revolutions.	876	882	888	895	902	908	914	920	926	930
15¼	Horse Power.	86.9	89.0	91.1	93.1	95.2	97.0	99.0	101.0	103.3	105.1
	Cubic Feet.	730	738	742	748	753	758	764	770	774	778
	Revolutions.	762	768	773	778	783	788	793	798	803	808
17½	Horse Power.	114.0	116.1	118.4	122.8	125.5	128.0	130.3	132.2	134.5	136.2
	Cubic Feet.	956	967	976	982	985	992	1000	1008	1013	1016
	Revolutions.	664	668	672	677	681	687	691	696	700	704
20	Horse Power.	149.4	152.8	156.3	161.0	164.1	167.4	170.5	174.0	177.2	180.1
	Cubic Feet.	1300	1308	1316	1324	1336	1344	1352	1360	1368	1376
	Revolutions.	580	585	589	593	597	601	605	609	613	617

TABLE Arranged Specially for the Poole & Hunt Leffel Turbine Water Wheel.

SIZE OF WHEELS		HEAD IN FEET. 81	82	83	84	85	86	87	88	89	90
$7\frac{5}{8}$	Horse Power.	20.0	20.4	20.8	21.0	21.4	21.8	22.2	22.6	23.1	23.6
	Cubic Feet.	151	152	153	154	155	156	157	158	159	160
No. 1.	Revolutions.	1626	1636	1646	1656	1666	1674	1684	1694	1704	1714
$7\frac{5}{8}$	Horse Power.	26.5	27.0	27.5	28.0	28.5	29.0	29.5	30.0	30.4	31.1
	Cubic Feet.	203	204	205	206	207	208	210	212	213	214
	Revolutions.	1626	1636	1646	1656	1666	1674	1684	1694	1704	1714
10	Horse Power.	34.8	35.6	36.5	37.1	37.7	38.2	39.0	39.7	40.3	41.0
	Cubic Feet.	255	257	258	260	262	263	264	266	267	269
No. 1.	Revolutions.	1242	1250	1257	1264	1272	1280	1287	1294	1301	1308
10	Horse Power.	45.8	46.6	47.2	48.1	49.0	50.0	51.0	52.0	52.8	53.6
	Cubic Feet.	346	348	350	352	354	356	358	360	362	364
	Revolutions.	1242	1250	1157	1264	1272	1280	1287	1294	1301	1308
$13\frac{1}{4}$	Horse Power.	60.5	61.6	63.0	64.1	65.9	66.2	67.3	68.6	69.4	70.8
	Cubic Feet.	450	453	456	460	463	465	468	470	473	476
No. 1.	Revolutions.	936	941	948	954	960	965	970	976	981	987
$13\frac{1}{4}$	Horse Power.	80.5	82.0	83.5	85.0	86.6	88.0	89.6	91.1	92.5	94.1
	Cubic Feet.	604	608	610	612	615	620	623	626	630	634
	Revolutions.	936	941	948	954	960	965	970	976	981	987
$15\frac{1}{4}$	Horse Power.	106.9	108.5	110.0	112.0	114.1	116.2	118.1	120.0	122.2	124.4
	Cubic Feet.	782	786	790	796	801	805	809	814	820	826
	Revolutions.	813	818	823	827	833	836	841	848	855	862
$17\frac{1}{2}$	Horse Power.	139.0	142.3	146.0	148.4	150.8	152.7	155.5	158.7	161.2	164.0
	Cubic Feet.	1020	1028	1032	1040	1048	1052	1056	1063	1068	1075
	Revolutions.	708	712	716	721	726	731	735	739	743	747
20	Horse Power.	183.2	186.4	189.2	192.5	196.2	200.0	203.8	207.5	211.4	214.2
	Cubic Feet.	1384	1392	1400	1408	1416	1424	1432	1440	1448	1456
	Revolutions.	622	625	628	632	636	640	643	646	650	654

TABLE Arranged Specially for the Poole & Hunt Leffel Turbine Water Wheel.

SIZE OF WHEELS		HEAD IN FEET. 91	92	93	94	95	96	97	98	99	100
$7\frac{5}{8}$	Horse Power.	24.0	24.3	24.8	25.3	25.7	26.2	26.5	26.8	27.0	27.3
	Cubic Feet.	161	162	163	164	165	166	167	168	169	170
No. 1.	Revolutions.	1724	1734	1743	1752	1761	1772	1780	1789	1797	1808
$7\frac{5}{8}$	Horse Power.	31.6	32.0	32.6	33.0	33.7	34.2	34.9	35.5	36.0	36.6
	Cubic Feet.	215	216	217	218	219	220	221	222	224	226
	Revolutions.	1724	1734	1743	1752	1761	1772	1780	1789	1797	1808
10	Horse Power.	41.5	42.2	42.8	43.5	44.0	44.5	45.1	46.0	46.9	48.0
	Cubic Feet.	270	272	273	275	277	278	280	281	283	285
No. 1.	Revolutions.	1315	1322	1329	1336	1343	1350	1357	1364	1371	1378
10	Horse Power.	54.4	55.2	56.0	56.9	58.0	59.1	60.0	61.0	62.1	64.0
	Cubic Feet.	366	368	370	372	374	376	378	380	382	384
	Revolutions.	1315	1322	1329	1336	1343	1350	1357	1364	1371	1378
$1\frac{1}{4}$	Horse Power.	71.9	73.2	74.1	75.5	76.8	78.1	79.1	80.4	82.0	83.2
	Cubic Feet.	479	482	485	488	490	492	494	497	500	502
No. 1.	Revolutions.	992	998	1004	1009	1015	1020	1025	1030	1035	1040
$13\frac{1}{4}$	Horse Power.	95.6	97.0	98.5	99.2	102.0	104.2	105.8	107.2	109.1	110.8
	Cubic Feet.	638	642	645	648	651	654	657	660	664	668
	Revolutions.	992	998	1004	1009	1015	1020	1025	1030	1035	1040
$15\frac{1}{4}$	Horse Power.	126.7	129.0	131.1	133.2	135.0	137.0	140.0	142.2	144.2	146.1
	Cubic Feet.	830	834	839	843	847	852	856	860	864	868
	Revolutions.	869	873	876	880	886	889	893	897	900	904
$17\frac{1}{2}$	Horse Power.	166.2	168.8	171.2	174.0	176.3	178.0	180.2	183.0	186.8	191.2
	Cubic Feet.	1080	1088	1092	1098	1107	1112	1120	1126	1132	1140
	Revolutions.	752	757	760	764	768	772	776	780	784	788
20	Horse Power.	217.6	221.2	224.0	227.6	232.0	236.4	240.0	244.2	248.4	252.7
	Cubic Feet.	1464	1472	1480	1488	1496	1504	1512	1520	1528	1536
	Revolutions.	657	661	664	668	671	675	678	682	685	689

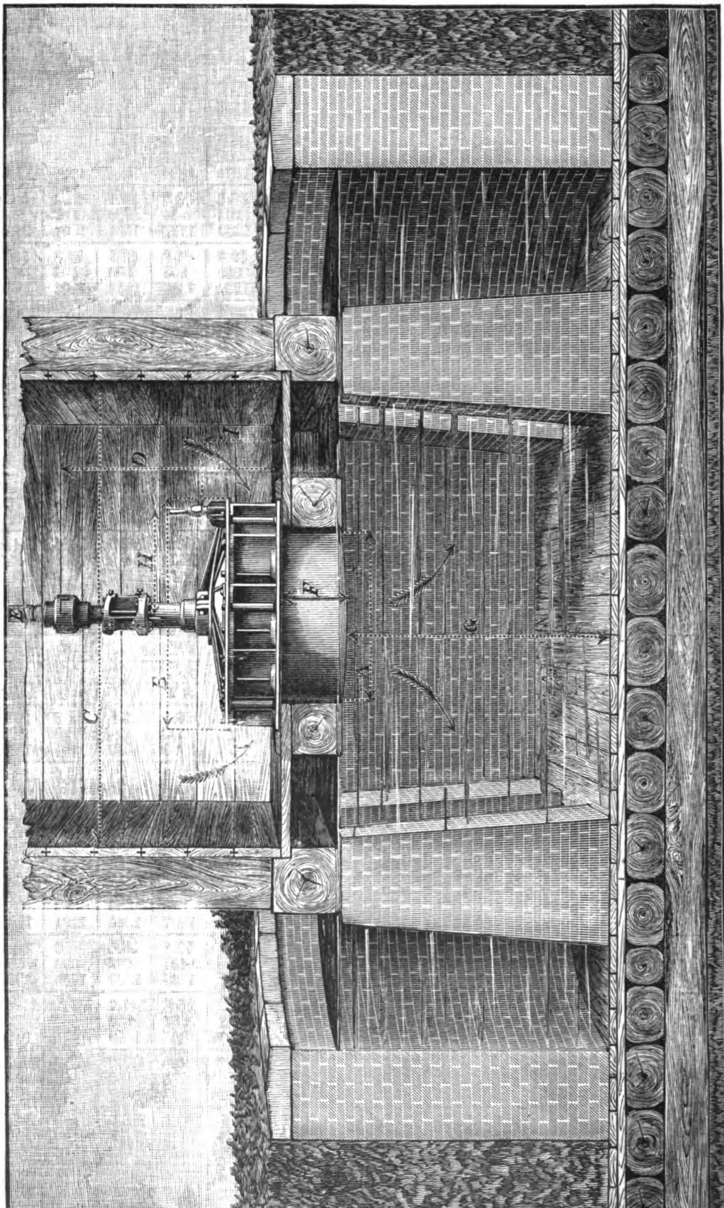


Plate No. 6.

PRINCIPAL DIMENSIONS OF
THE POOLE & HUNT LEFFEL WATER WHEEL,
CORRESPONDING WITH THE DOTTED LINES IN SKETCH ON PRECEDING PAGE.

All Dimensions are in ***inches.***

SIZE OF WHEELS.	A DIAMETER OF CYLINDER PASSING THROUGH FLOOR OF FLUME.	B DIAMETER OF WHEEL CASE.	C INTERNAL DIAMETER OF FLUME, ROUND OR SQUARE.	D HEIGHT FROM FLOOR OF FLUME TO TOP OF WHEEL SHAFT.	E BORE OF UPPER HALF OF COUPLING.	F DISTANCE FROM FLOOR OF FLUME TO BOTTOM OF CYLINDER.	G DEPTH OF STANDING TAIL WATER IN WHEEL PIT.	H DISTANCE FROM CENTRE OF WHEEL TO CENTRE OF GATE STEM.	I HEIGHT FROM FLOOR OF FLUME TO BOTTOM OF GATE STEM SOCKET.
10	$10\frac{9}{16}$	$14\frac{1}{2}$	30	$15\frac{3}{16}$	$1\frac{7}{16}$	$2\frac{3}{4}$	50	$6\frac{1}{2}$	$5\frac{1}{4}$
$13\frac{1}{4}$, No. 1.	14	$19\frac{1}{2}$	39	$19\frac{5}{8}$	$1\frac{15}{16}$	$3\frac{1}{8}$	50	$8\frac{5}{16}$	6
$13\frac{1}{4}$	14	$19\frac{1}{2}$	39	$20\frac{3}{8}$	$1\frac{15}{16}$	$3\frac{3}{4}$	50	$8\frac{5}{16}$	$6\frac{3}{4}$
$15\frac{1}{4}$	$16\frac{1}{4}$	23	46	$24\frac{1}{4}$	$2\frac{3}{16}$	$4\frac{1}{4}$	55	$10\frac{1}{4}$	8
$17\frac{1}{2}$	$18\frac{1}{2}$	$25\frac{1}{2}$	51	$24\frac{3}{4}$	$2\frac{3}{16}$	$4\frac{3}{4}$	55	$11\frac{7}{16}$	9
20	21	$29\frac{1}{4}$	58	30	$2\frac{15}{16}$	$5\frac{5}{8}$	55	$13\frac{1}{8}$	$10\frac{1}{2}$
23	$24\frac{1}{4}$	$31\frac{1}{4}$	66	31	$2\frac{15}{16}$	$6\frac{3}{4}$	60	$15\frac{3}{16}$	$11\frac{1}{4}$
$26\frac{1}{2}$	$27\frac{3}{4}$	$38\frac{5}{8}$	78	$37\frac{7}{8}$	$3\frac{7}{16}$	$7\frac{1}{4}$	60	$17\frac{1}{4}$	13
$30\frac{1}{2}$	$32\frac{1}{4}$	$44\frac{3}{4}$	90	$39\frac{3}{4}$	$3\frac{7}{16}$	9	65	$20\frac{1}{8}$	$14\frac{1}{2}$
35	$36\frac{5}{8}$	$50\frac{3}{8}$	102	48	$4\frac{7}{16}$	10	70	$22\frac{3}{4}$	17
40	$41\frac{7}{8}$	$56\frac{3}{4}$	114	$51\frac{3}{4}$	$4\frac{7}{16}$	$11\frac{3}{4}$	70	$25\frac{7}{8}$	19
44	46	61	120	54	$4\frac{15}{16}$	$12\frac{3}{4}$	75	$27\frac{3}{8}$	$20\frac{1}{2}$
48	$49\frac{3}{4}$	$66\frac{1}{4}$	132	$58\frac{3}{8}$	$5\frac{7}{16}$	$13\frac{3}{4}$	80	$30\frac{1}{4}$	22
52	$54\frac{1}{2}$	$74\frac{3}{4}$	148	$64\frac{3}{4}$	$5\frac{15}{16}$	15	85	$33\frac{3}{8}$	23
56	58	$78\frac{3}{4}$	156	67	$5\frac{15}{16}$	$16\frac{1}{2}$	96	$34\frac{11}{16}$	$24\frac{1}{2}$
61	$63\frac{1}{2}$	85	156	$71\frac{1}{2}$	$6\frac{7}{16}$	$17\frac{1}{2}$	96	$38\frac{3}{8}$	25
66	$68\frac{1}{4}$	$92\frac{3}{4}$	180	$78\frac{1}{4}$	$7\frac{7}{16}$	$19\frac{1}{4}$	96	42	$28\frac{1}{4}$

PRICE LIST
OF
The Poole & Hunt Leffel Water-Wheel.

Size of Wheels.					*Price of Standard Wheels.*	*Weight of Standard Wheels.*	*Price of Special Wheels.*
$7\frac{5}{8}$ No. 1	Brass	Wheel,	Steel	Gates,	$180.00	70	
$7\frac{5}{8}$	“	“	“	“	185.00	80	
10 No. 1	“	“	“	“	190.00	110	
10	“	“	“	“	195.00	125	
$13\frac{1}{4}$ No. 1	“	“	“	“	200.00	180	
$13\frac{1}{4}$	“	“	“	“	210.00	200	
$15\frac{1}{4}$	Iron	Wheel,	“	“	185.00	300	
$17\frac{1}{2}$	“	“	“	“	195.00	365	
20	“	“	“	“	205.00	600	$215.00
23	“	“	“	“	225.00	700	235.00
$26\frac{1}{2}$	“	“	“	“	265.00	1,200	275.00
$30\frac{1}{2}$	“	“	“	“	300.00	1,500	315.00
35	“	“	Iron	Gates,	335.00	2,300	350.00
40	“	“	“	“	385.00	3,000	400.00
44	“	“	“	“	425.00	3,700	440.00
48	“	“	“	“	500.00	4,500	520.00
52	“	“	“	“	620.00	5,500	645.00
56	“	“	“	“	720.00	6,200	750.00
61	“	“	“	“	815.00	8,200	850.00
66	“	“	“	“	940.00	10,500	980.00

The above named price is for the wheel as illustrated on page 4 of this pamphlet.

In ordering, state whether the wheels are to run with or against the sun.

DIRECTIONS FOR SETTING OUR LEFFEL-WHEEL.

We have endeavored, in the following article, to give a few rules, embracing the important principles to be observed in putting in our wheel. These rules are stated as plainly as possible, in order to avoid any misunderstanding in their application; and if they are carefully followed the wheel cannot fail to work as represented by us.

THE HEAD-RACE,

in constructing which, a very frequent error is committed in failing to give it sufficient capacity. It should be made both wide and **deep**; and this is especially necessary where the race is of considerable length, and a large quantity of water is to pass through it. It is difficult to give a definite rule which will apply to every case; but it may be stated as a general rule that the water should not flow faster than 100 feet per minute. In cases where there is a long race, after the wheel has been running three or four hours, the head frequently draws down from one to three feet. The effect of this is precisely the same as if the dam had been lowered an equal distance—resulting in a loss of power which would have been prevented by making the race as wide and deep as it should be.

THE WHEEL-PIT

must next be located; and we cannot too strongly impress the importance of a proper depth of the pit. This is a point in which mill-owners and millwrights, in putting in our wheel, are more liable to err than in any other. In fact, if a person should write us, "Your wheel is not doing as represented," the first question we would ask is, "What depth have you below the wheel?" Whether under high or low head, the pit should be made deep and wide. There is no case where this is more important than where a large wheel is run under a low head; as under these circumstances no loss of head, however small, can be afforded. A pit of insufficient size causes the water to react upon the wheel; and an additional loss of power is also caused by the fact that a portion of the head is consumed in forcing the water out of the pit when there is not sufficient outlet. As a general rule, the depth of the pit should not be less than 30 inches for the smallest wheels, and in some cases as much as 6 or 8 feet for the largest wheels under high heads. An average size wheel, say a 48-inch, under an average head, say 12 feet, should have 80 inches clear space from the mouth of the cylinder or wheel-tube, where the water discharges from the wheel, to the bottom of the pit. (See table opposite Plate 6.)

In making the pit, if there is a sandy or mud-bottom, to keep the foundations from washing out, mud-sills must be put down as shown in Plate 6, and on these sills should be placed a 2½-inch plank-floor. A rock-bottom does not require mud-sills or plank, but must be blasted out so as to give the proper depth of standing tail-water. (See Plates 5, 8, 9.) This depth should be continued the whole length and breadth of the flume, and, if possible, from two to four feet beyond the sides; but in all cases it must

extend from five to twenty feet down the tail-race from the end of the flume. We wish to most strongly impress the fact that the water cannot discharge too freely from a wheel.

THE TAIL-RACE,

as well as the wheel-pit, should be both wide and deep; and, if possible, the level of the bottom of wheel-pit should be carried out the whole length of the tail-race to the stream, which is easily done when the race is short and empties directly into the stream. Where the desired depth cannot be given the whole length of the race, it should be made up in width; and in this case the bottom of the tail-race should slope gently to the bottom of the wheel-pit, in order to avoid an abrupt opposing surface. There should be, if possible, two feet in depth of dead water in the tail-race when the wheel is not running, in order to avoid the raising of the water in the tail-race and consequent loss of head. The race should also be much wider than it is usually made; and its sectional area should not in any case be less, but should, if possible exceed that of the outlet of the wheel-pit. By the sectional area is implied the product of the width and depth multiplied together. A wheel-pit three feet deep and ten feet wide has thirty square feet sectional area. It is of as much importance that the tail-race should be made wide and deep as that the head-race should be; and neither can be made too large.

SIZE OF PENSTOCK.

We have given in column C (Table of Dimensions) the inside diameter of penstock for each size wheel; and by reference to the plate on the opposite page, the required diameter can be readily found. These are the least dimensions which it is expedient to employ.

SIZE OF FLUME OR CONDUIT.

As we have already stated, the flume or forebay conducting the water to the penstock should be sufficiently large to deliver the water smoothly and quietly in the penstock, without loss of head. The water in the penstock, in order to give the best results, should be as nearly as possible without motion, except the natural current or suction toward the wheel.

In no case should light, weak timbers be used for the bottom of penstocks. The side sills should be 12 inches square, providing 10-inch square posts are used, which will be heavy enough for 10 to 15 feet head. For 12 by 14 inch sills, 12-inch posts may be used. If the corner posts are rabbeted, they should be 12 by 14, or 14 by 16 inches square, so as to rabbet four inches one way and two inches the other. The intermediate sills may be narrow one way and placed edgewise up and down; and in large flumes these may be supported by two or three posts of stiff, hard timber, or by iron columns, placed solidly on the foundations.

In some plates we show the penstock resting on stone piers. This is not absolutely necessary, as the side post of the penstock can extend down to the apron or bottom of the pit, the lower ends of the posts resting on mud-sills where the bottom is mud or sand (with the sills of the penstock framed into the posts), or on rock, if the bottom is of that nature.

In the case of large penstocks, we would advise that they should rest either on stone pillars or side-walls; but pillars are decidedly the best, especially where the tail-race or wheel-pit can be made wider than the penstock, as they allow a free discharge of water in all directions.

For the floor of the flume, 2½ or three inch planks should be laid on the sills of the penstock and spiked down. A hole must be cut in the floor of sufficient size to allow the cylinder of the wheel to pass through. The diameter of this hole is given in Table of Dimensions; surrounding the hole, soft pine planks should be placed, extending a little beyond the flange of the wheel, and beveled as shown in Plate 11. These planks must be beveled and planed off perfectly true. The flange of the wheel rests upon the planks, the cylinder passing down through the hole, and its end dipping two or more inches below the surface of standing tail-water. No fastening is necessary to keep the wheel in position, as its own weight and the pressure of the water will hold it in place.

DRAFT TUBE.

In adapting wheels to very high falls, it sometimes becomes desirable, in order to avoid extreme length of shaft on the wheel, and also to otherwise conform it to the peculiar location of the mill, to place the wheel at a distance above tail-water, and conduct the water away from the wheel by an air-tight tube, called a Draft Tube. It is also desirable in some cases, when the outlet is cramped, to employ a short draft-tube, say of two or three feet length, thus bringing the lower timbers of the penstock up from the water, and allowing a free discharge; and likewise affording greater convenience in getting at the wheel. There cannot be, ordinarily, any objection to the use of a draft-tube not to exceed ten feet in length, as within that limit, by good workmanship and proper material, a tube can be constructed both air-tight and durable; yet, as want of experience in this matter might lead to mistakes which would tend to greatly diminish the power of the wheel, we would here state that, as a rule, we would advise the wheel to be placed at the bottom of the fall. When the draft-tube exceeds ten feet in length, and particularly when used for small wheels, it should be made of boiler iron, as our experience has taught us that when a tube is of great length, a wooden tube cannot be relied on either as water-tight or durable.

The end of the draft-tube should dip two or three inches below the surface of standing tail-water. The same care is necessary in making the wheel-pit when a draft-tube is used, as when a wheel is put in without the tube. For information on this point, reference should be made to the oregoing articles on that subject.

EXPLANATION OF PLATE No. 7.

Plate No. 7 shows a plan for driving a small flouring-mill of two run of stones by a small Leffel wheel under a head, say, of 25 to 30 feet, or more. The wheel is contained in an iron globe-case, and has a short draft-tube. The power is taken off by belting, one belt for each pair of burrs, and a separate belt for the vertical shaft that drives the elevators, conveyors, and other machinery.

Many persons experience much trouble and annoyance from using pulleys of small diameter, and wide belts. The better plan is to have the pulleys of large diameter, and the belts narrow.

Our practice is to make the pulley on the spindle of stones, the same diameter as the stone that it drives. In such a case, a belt six or seven inches wide is sufficient for ordinary country work.

In the plate, a corner of the mill-house is removed, in order that the arrangement of the machinery within may be seen.

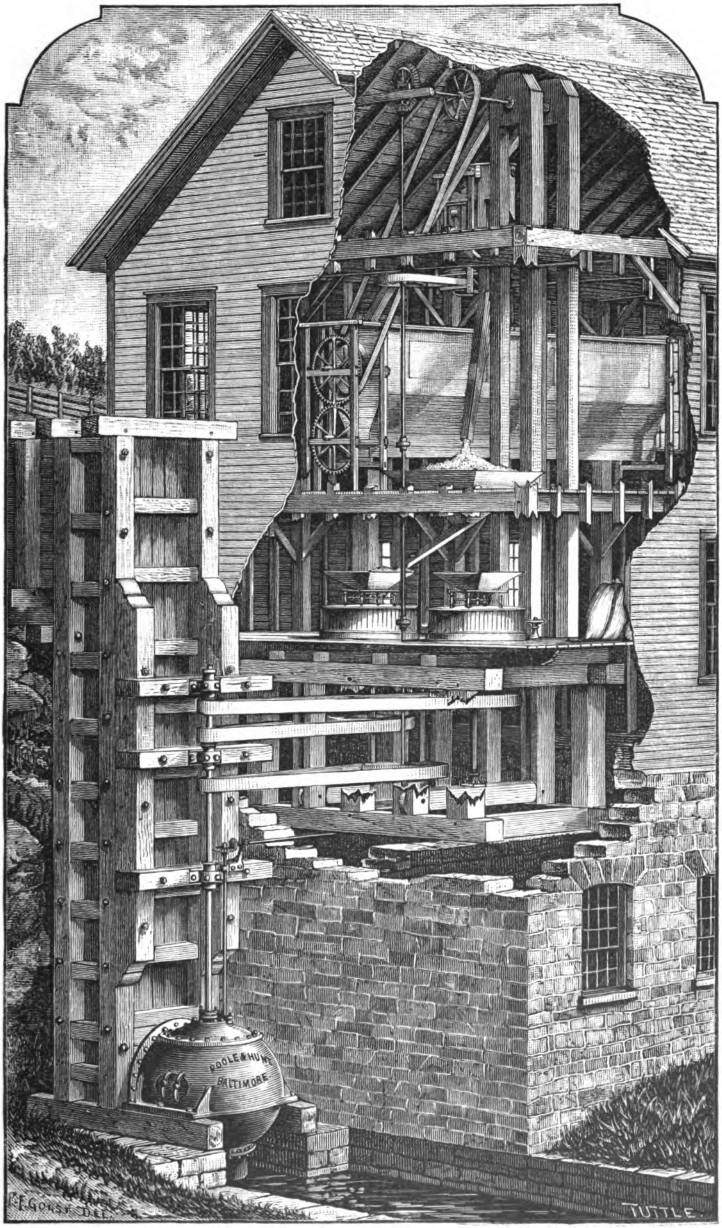
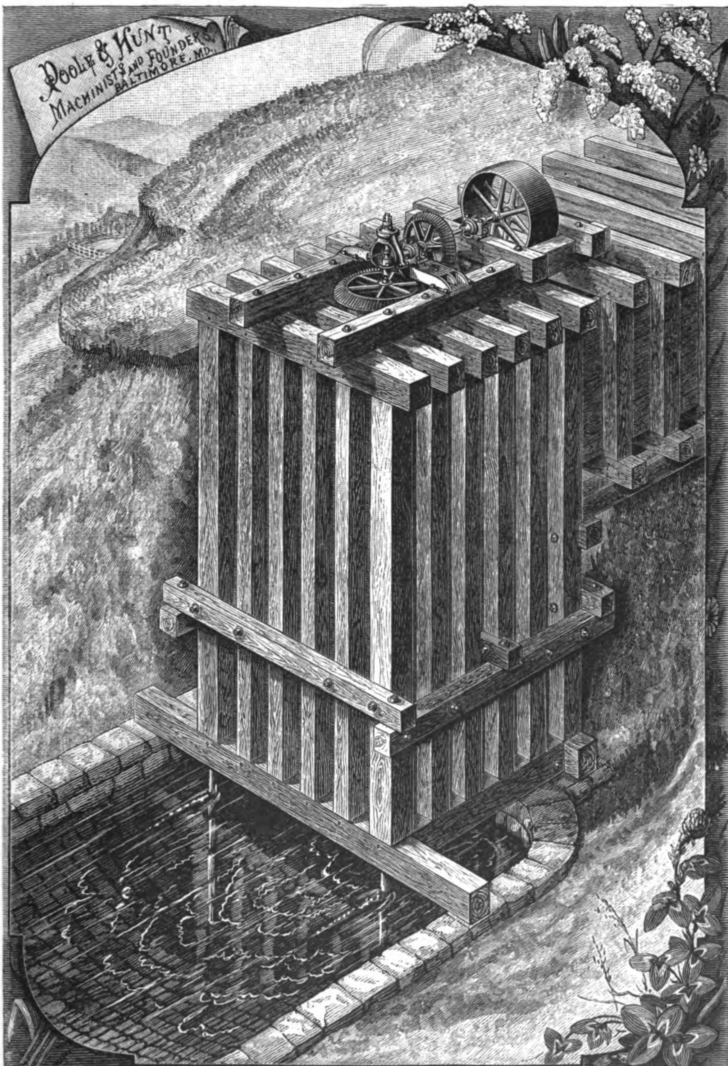


Plate No. 7.

EXPLANATION OF PLATE No. 8.

Plate No. 8 shows an example of a plain open top wooden penstock, with bevel gearing, iron pedestal plate, horizontal shaft, and driving pulleys in place. This illustrates a first-class arrangement of its kind, and is adapted to a great variety of purpose and location.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MACHINISTS AND FOUNDERS
BALTIMORE, MD.
TUTTLE-Sc-NY.

Plate No. 8.

EXPLANATION OF PLATE No. 9.

In Plate No. 9 we have endeavored to show the arrangement of timbers in an ordinary plain wooden penstock, or flume.

The illustration is so plain, that further description is unnecessary.

We give it as a design for a well-constructed penstock, but variations may be made as locality may require, or the skill of the builder suggest.

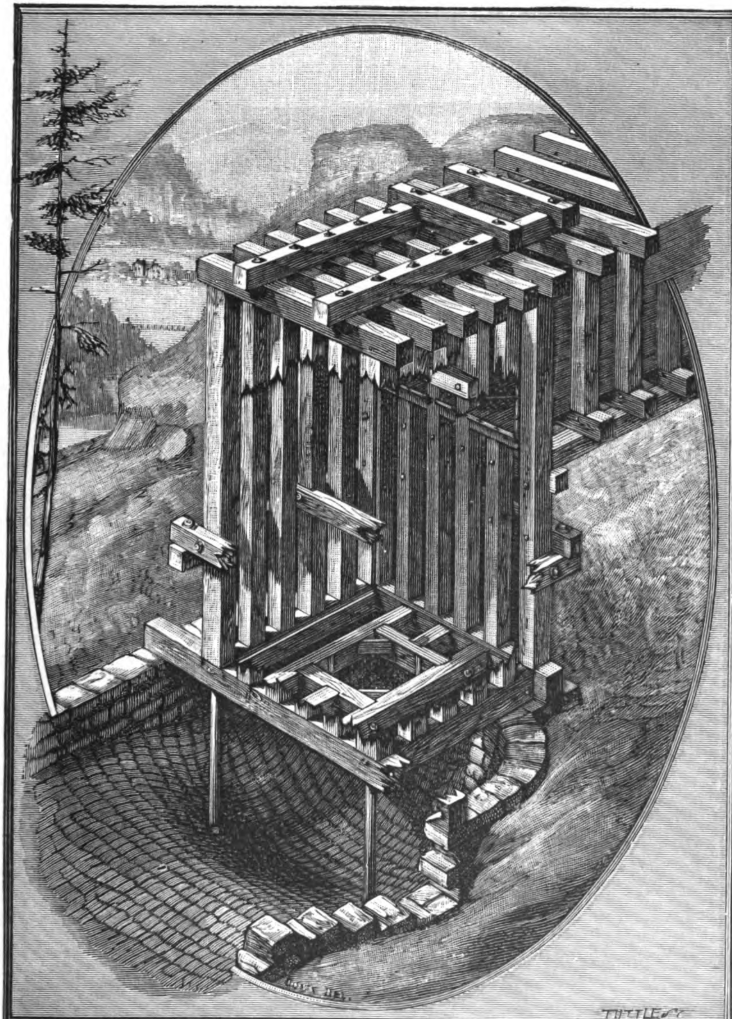


Plate No. 9.

EXPLANATION OF PLATE No. 10.

Plate No. 10 is an enlarged view of the timbers at top of penstock (shown in Plate No. 8), with gearing, iron pedestal plate, horizontal shaft, and driving pulley or drum, with thrust bearing in place at top of turbine-shaft.

Much trouble and loss of time and money results from improper arrangement of bearings of vertical and horizontal shafts, causing breakage of gearing, and undue wearing of shafts, in consequence of the gears not being held firmly in correct relative position, and the shafts not being properly supported by the bearings.

A well-devised iron pedestal plate obviates these troubles, and in connection with a good thrust-bearing to sustain the weight of vertical shaft and gear thereon, constitutes a first-class construction.

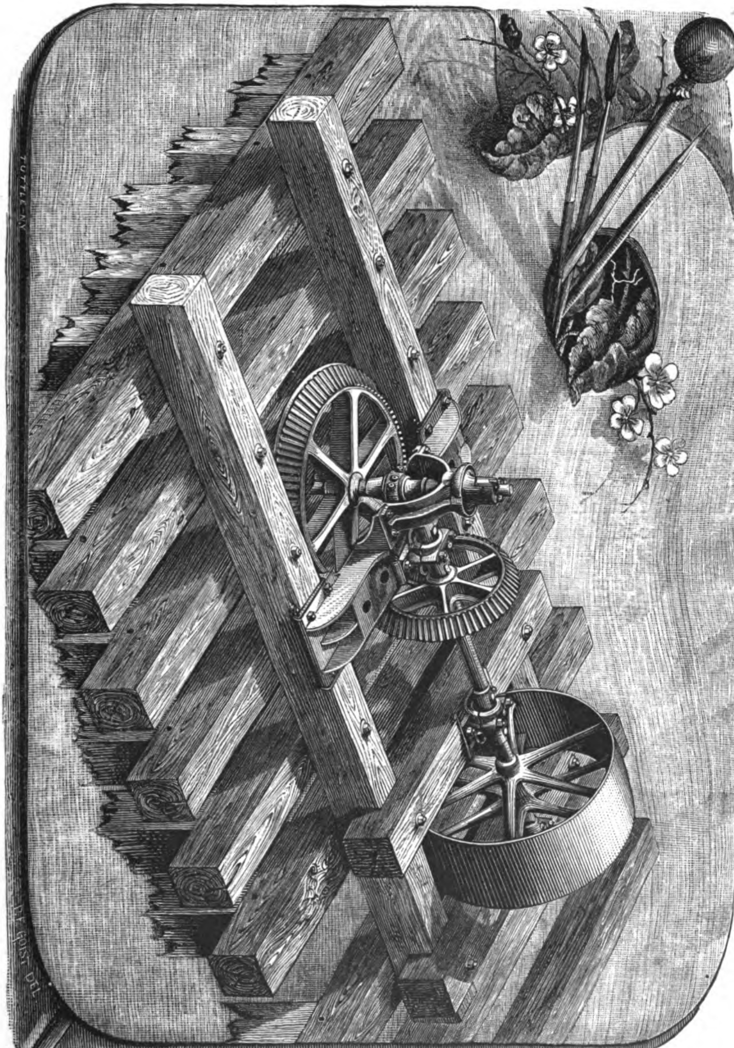


Plate No. 10.

EXPLANATION OF PLATE No. 11.

Plate No. 11 shows a section of wooden penstock, with water-wheel in position, supplied with a short draft-tube, which keeps the sill timbers out of the water at all times, adding greatly to their durability, and keeping them out of the way of the free escape of tail-water, which is a very valuable feature. Iron supporting columns are shown under the intermediate floor-sills, preventing the settling of the floor, and consequent throwing of turbine out of line. In this example, the bottom of pit, under the wheel, is paved with stone.

The dimension-letters are the same as those in Plate No. 6.

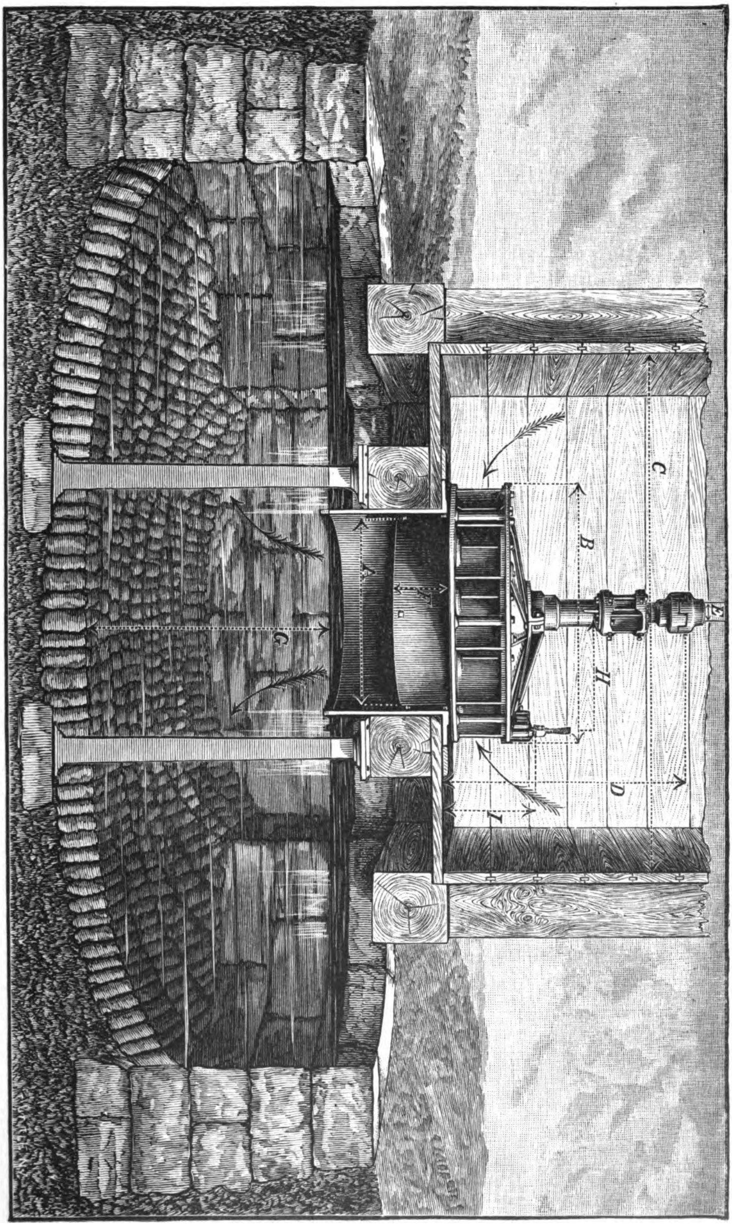


Plate No. 11.

EXPLANATION OF PLATE No. 12.

Plate No. 12 shows a "thrust-bearing," with head of vertical shaft projecting through. The sustaining key, and adjusting set-screws are also shown.

This is an admirable arrangement for sustaining the weight of a vertical shaft, and machinery attached thereto. It is a great aid in holding gearing in proper contact, and its use saves much trouble and loss of time.

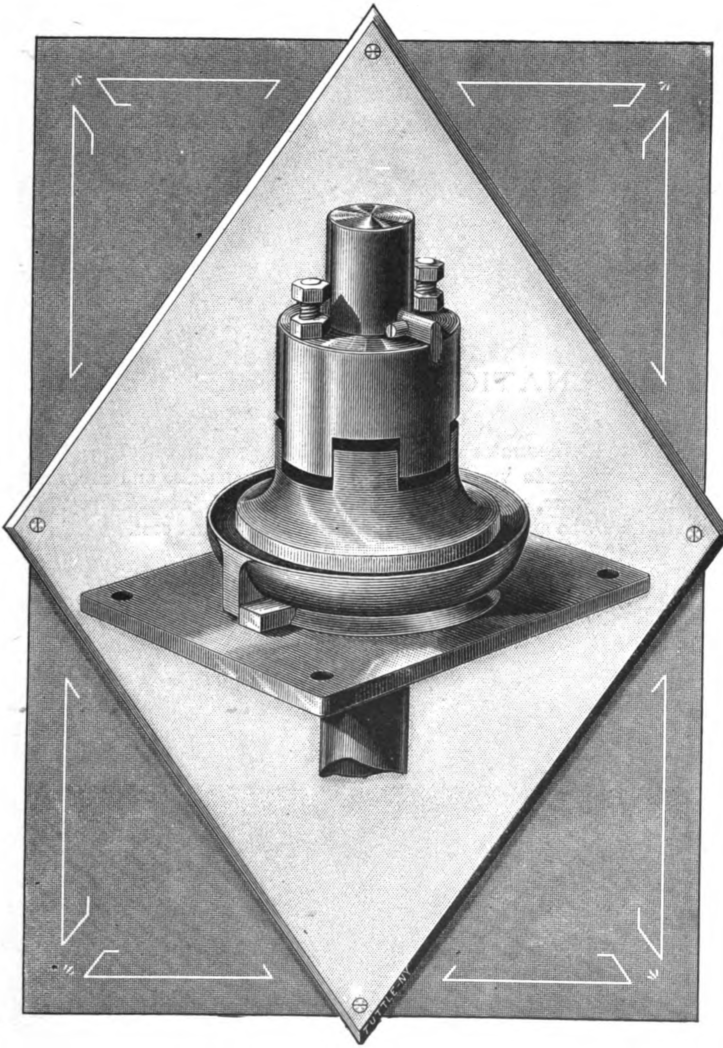


Plate No. 12.

EXPLANATION OF PLATE No. 13.

Plate No. 13 illustrates our iron globe casing, with wheel in place. These cases are made very strong, of the best materials, and are well fitted up. They are, of course, very durable, and their adoption pays, in the end, those who are willing to incur the additional first cost.

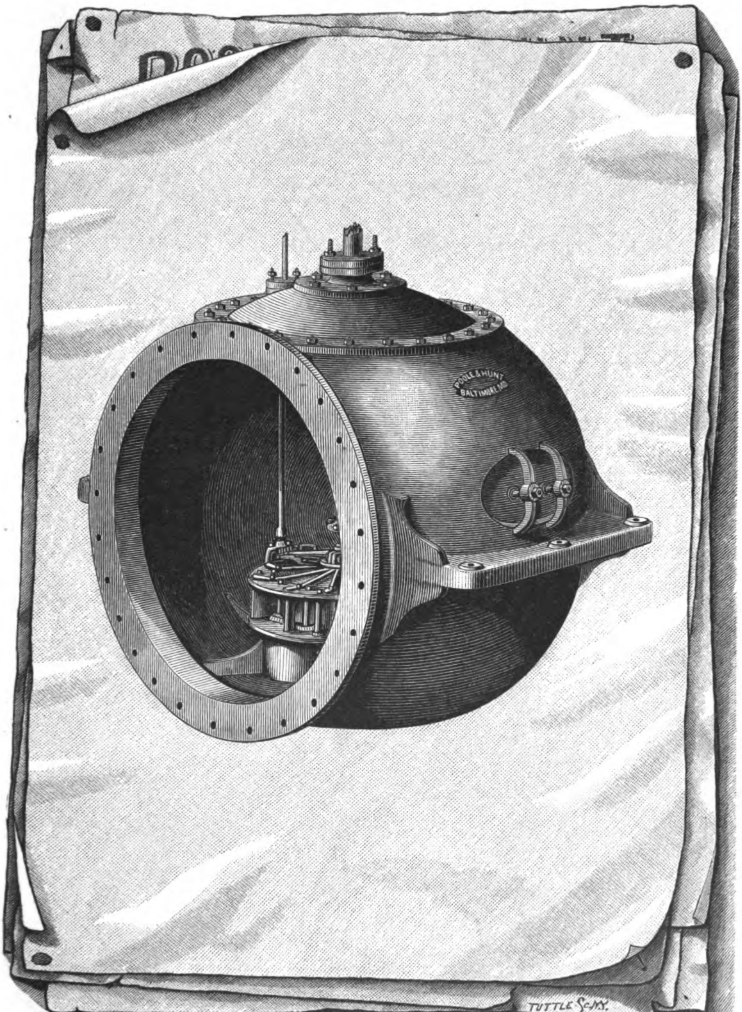


Plate No. 13.

EXPLANATION OF PLATE No. 14.

Plate No. 14 shows a small wheel in an iron casing, similar to that shown in Plate No. 13, but having the addition of a short draft-tube, and an iron stand and bearing attached to top of casing, supporting a pulley for delivering the power.

This is an excellent arrangement, in cases where moderate power has to be transmitted, at a high speed.

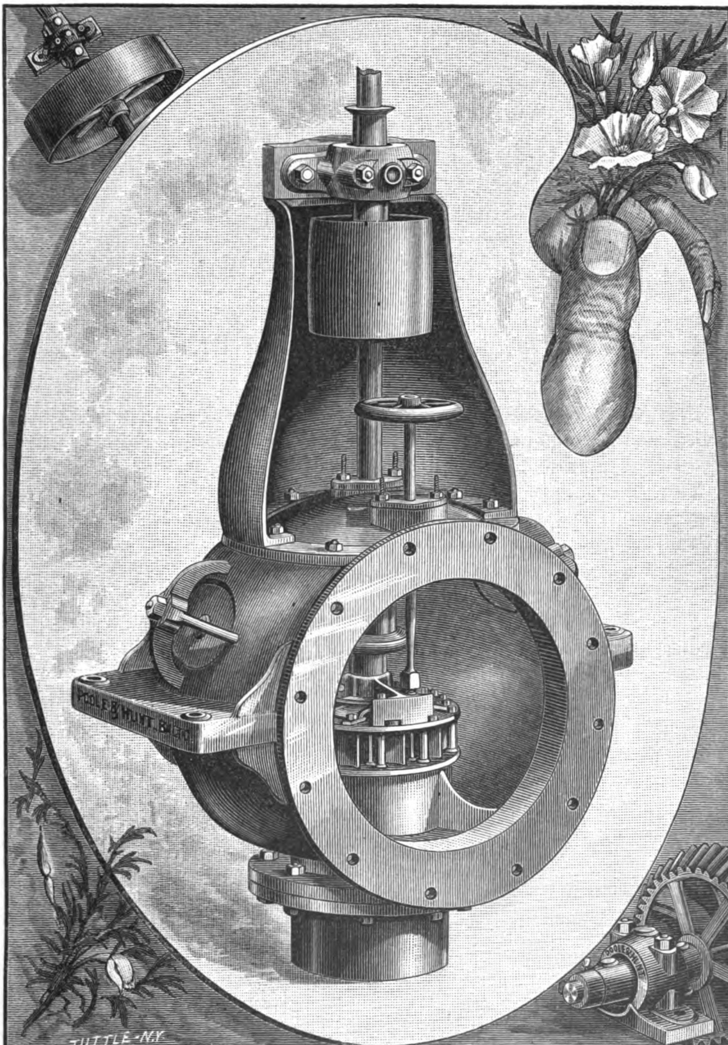
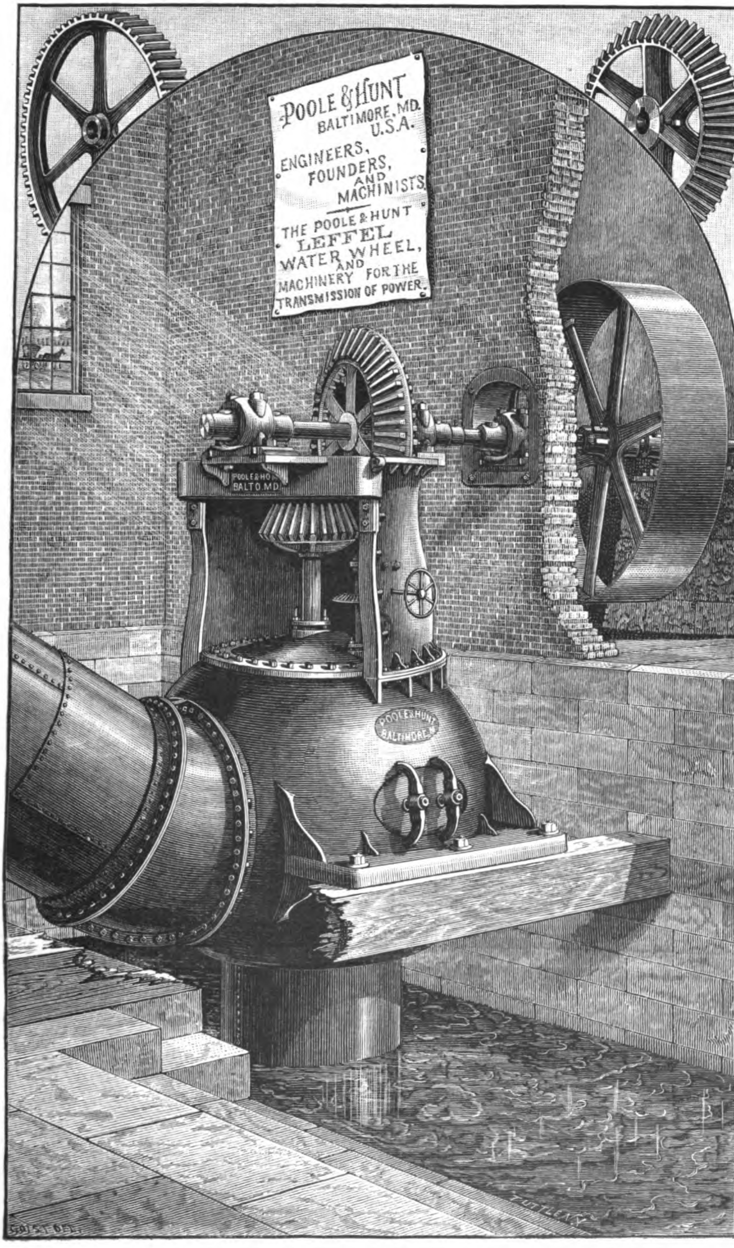


Plate No. 14.

EXPLANATION OF PLATE No. 15.

Plate No. 15 shows a larger wheel in cast-iron case with iron inlet pipe, draft tube and bevel-gearing, iron-gearing stand, horizontal shaft and driving-drum, arranged for driving a cotton-mill.

This, as is the case with the other illustrations in this book, is taken from actual practice, and represents a wheel and attachments, which have been in successful operation for several years.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TRANSMISSION OF POWER.
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BALTIMORE, MD.

Plate No. 15.

EXPLANATION OF PLATE No. 16.

Plate No. 16 represents two wheels of different sizes, in casings composed of cast and wrought iron, suspended from two cast-iron girders. The horizontal shaft and gearing are supported by cast-iron stands, spanning from one girder to the other. A friction-clutch is provided, so that the smaller of the two water-wheels may be disengaged, when the supply of water is inadequate for both wheels, the arrangement being designed for use on a variable stream.

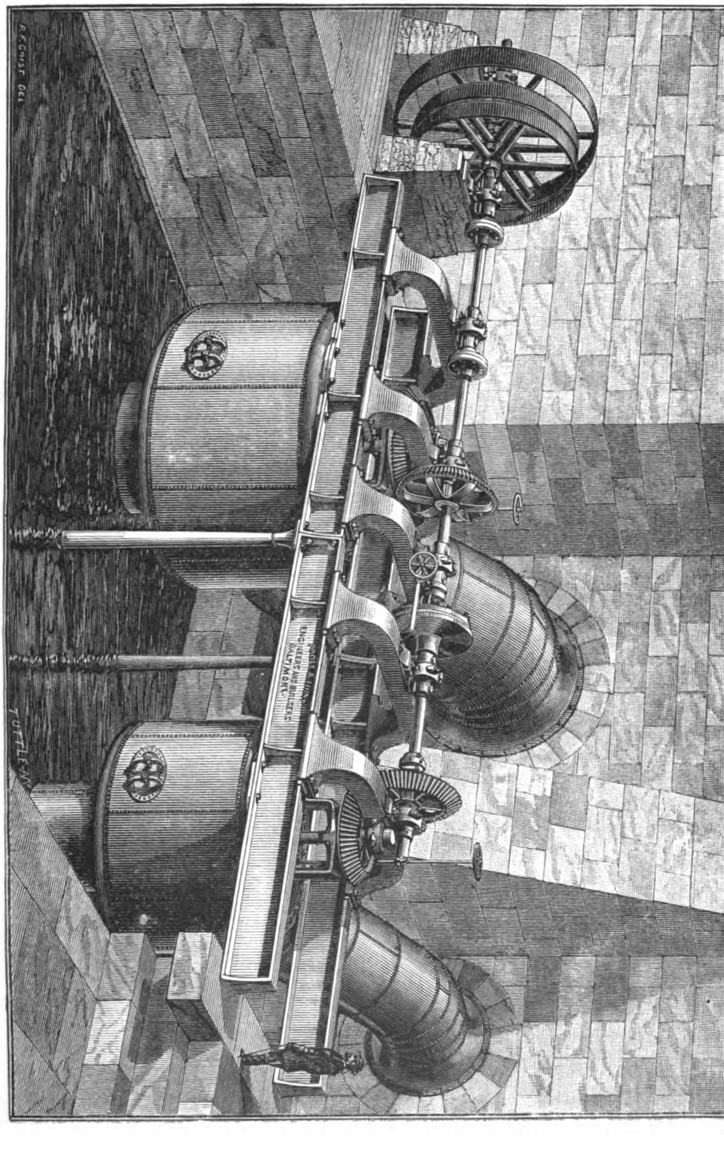
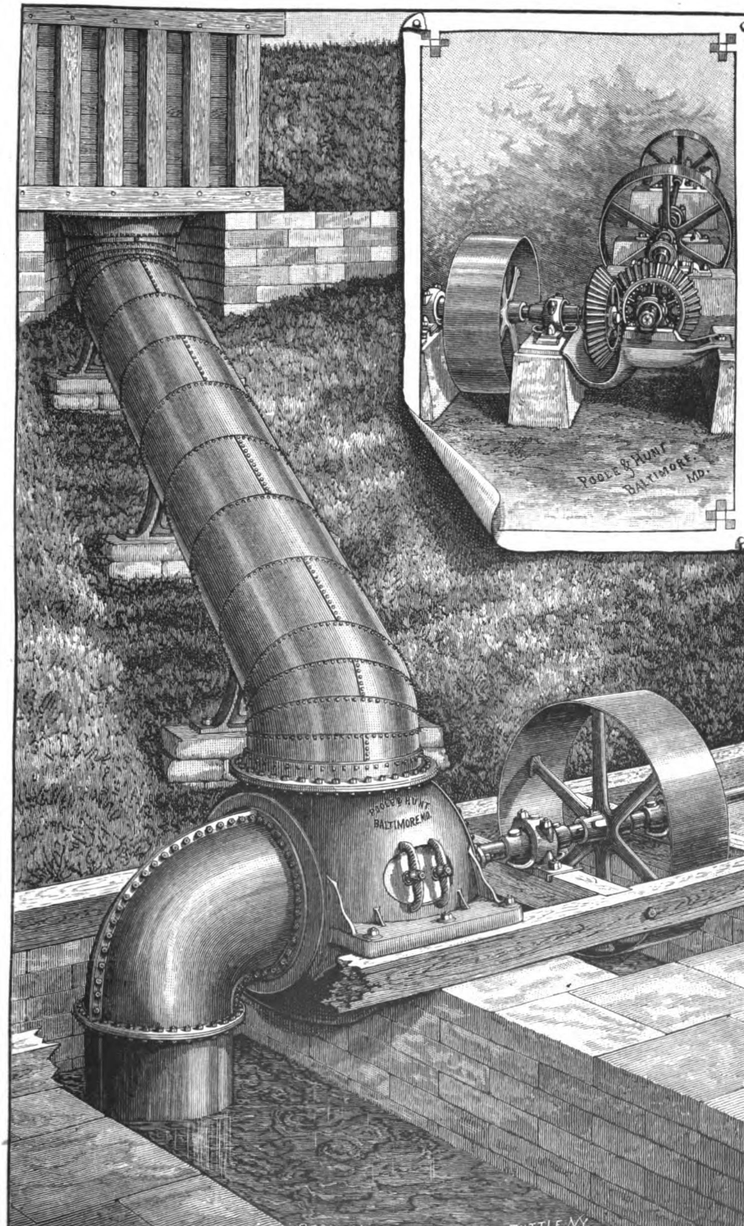


Plate No. 16.

EXPLANATION OF PLATE No. 17.

Plate No. 17 illustrates a wheel running horizontally, under a rather high head, and applied to driving a cotton-mill. The draft-tube, in this example, connects to the iron casing, by a cast-iron elbow. The front supporting timber is shown broken off, so that a full view may be had of the draft-tube. The inclined inlet-pipe is supported by stone piers, surmounted by cast iron stands.

The cut in the right-hand upper corner shows an arrangement of masonry and iron pedestal plate, for the support of a pair of bevel gears, and ends of the two horizontal shafts connected by the gearing.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BALTIMORE MD.
P.F. GOIST DEL.
TUTTLE N.Y.

Plate No. 17.

EXPLANATION OF PLATE No. 18.

Plate No. 18 shows the case or penstock of combined cast and wrought iron, containing two water-wheels on horizontal shaft, plate-iron inlet-pipe and draft-tube, and cast-iron supporting girders.

A portion of the bulkhead is removed in the cut, to show the rack-bars beyond.

The arrangement of turbines on horizontal shafts is an excellent one, where the circumstances permit such an application, as it dispenses with gearing, and operates with little noise.

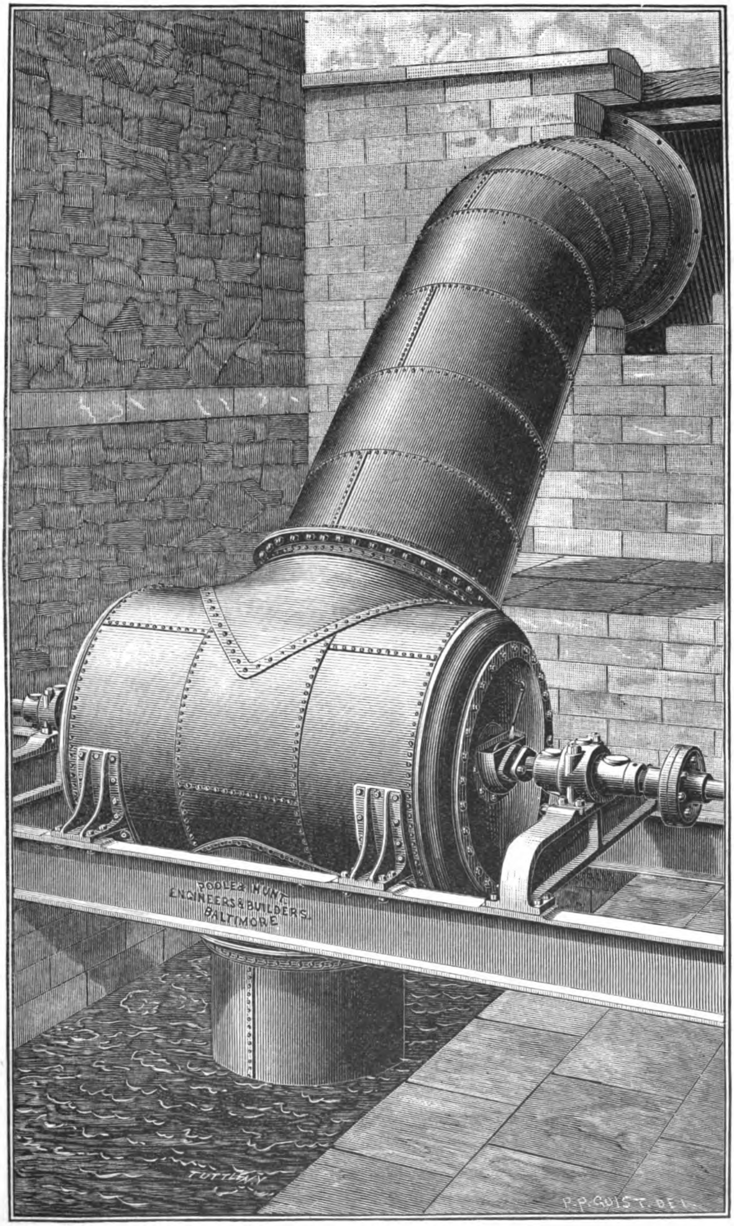


Plate No. 18.

EXPLANATION OF PLATE No. 19.

Plate No. 19 shows an arrangement very similar to that shown in No. 18.

The main power is taken off at one end from a large iron drum, having a double set of arms.

From the other end of shaft, the fire-pump is driven, arranged to be thrown in and out of gear by a friction-clutch, operated by appropriate mechanism.

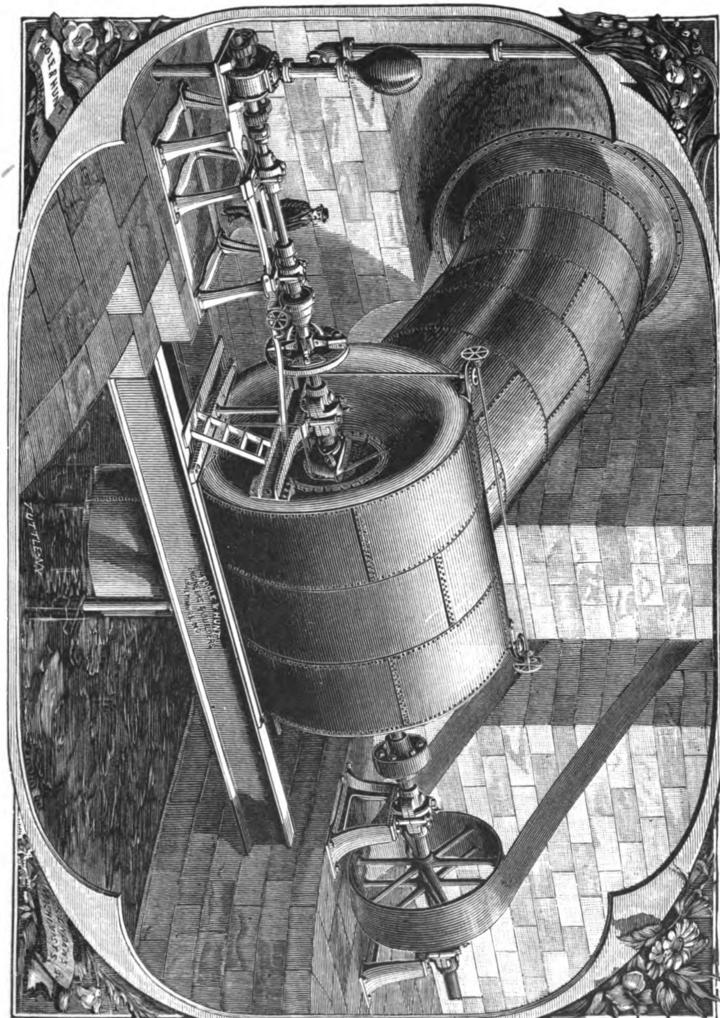


Plate No. 19.

EXPLANATION OF PLATE No. 20.

Plate No. 20 illustrates the vertical and horizontal parts of a large flume and casing, of combined plate and cast-iron, containing four turbines, on two horizontal shafts.

These wheels drive a large pulp-mill in Vermont, and develop about one thousand horse-power.

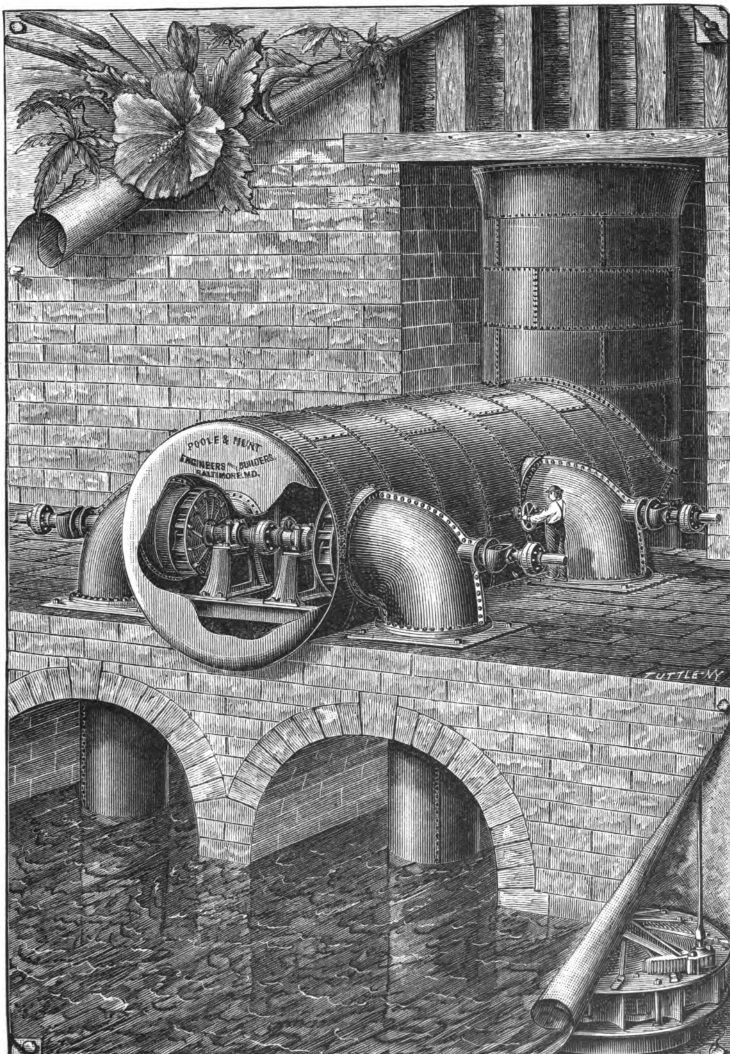


Plate No. 20.

EXPLANATION OF PLATE No. 21.

Plate No. 21 shows a wheel in iron globe case, draft-tube and elbow, and feet for supporting the structure upon timbers, or other suitable base.

Plates Nos. 22 and 23 illustrate the parts of our Leffel Wheel in detail. Designating numbers are affixed for convenience of customers, in ordering parts for repairing wheels in use.

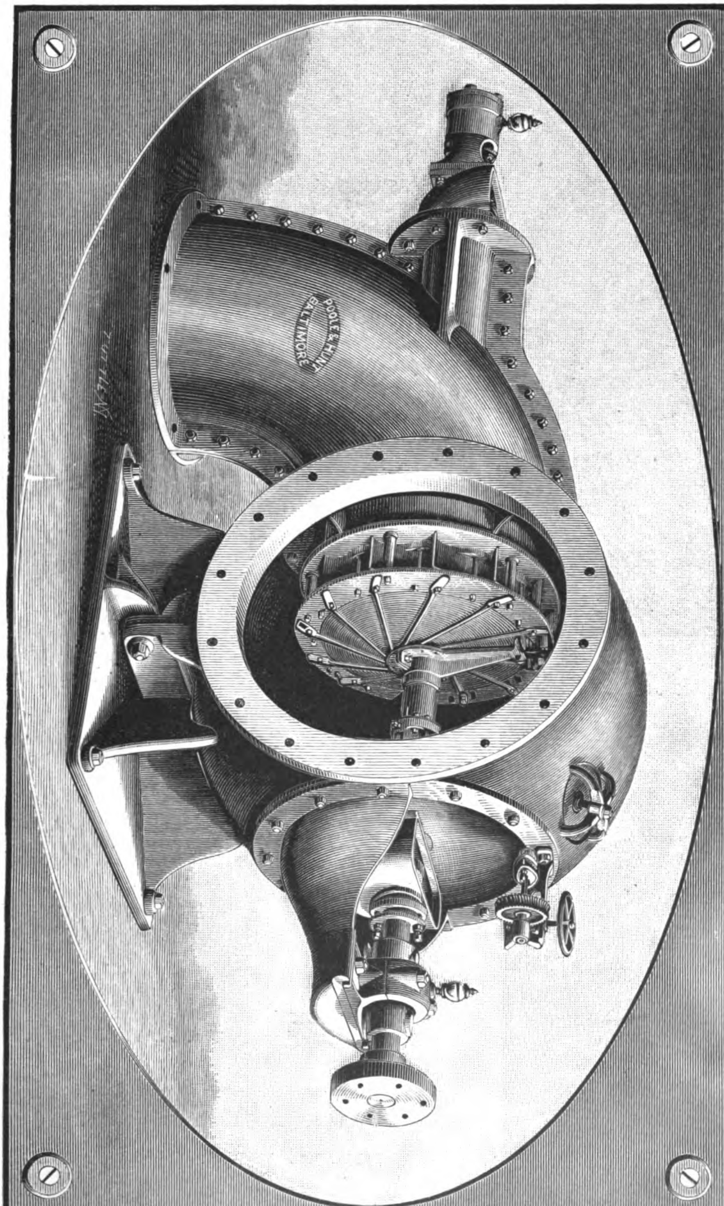
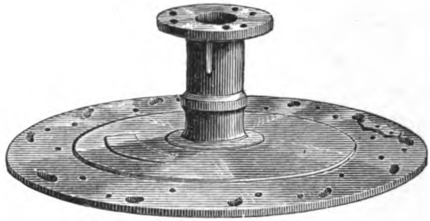
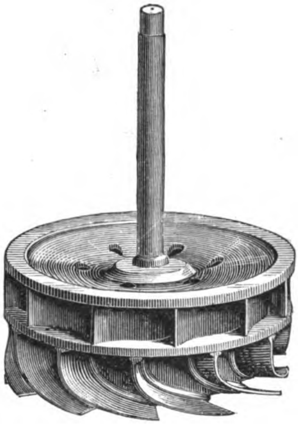


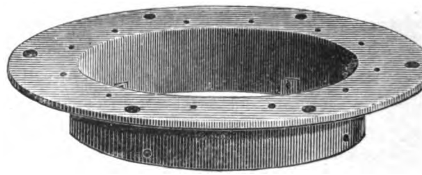
Plate No. 21.



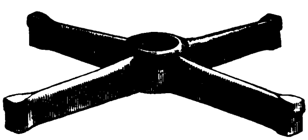
No. 2. Crown Plate.



No. 1. Wheel and Shaft.



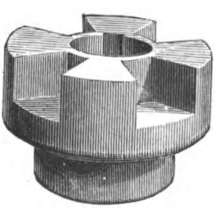
No. 3. Cylinder.



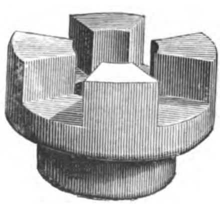
No. 4. Bridge-tree.

No. 5. Bolt for Bridge-tree.

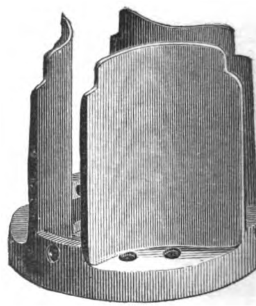
No. 6. Wooden Step.



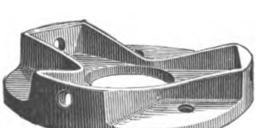
No. 7. Lower-half Coupling.



No. 8. Upper-half Coupling.



No. 9. Bush Body.

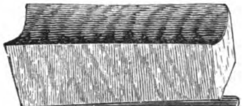


No. 10. Cap for Bush Body.

No. 11. Bolt for Cap to Bush Body.

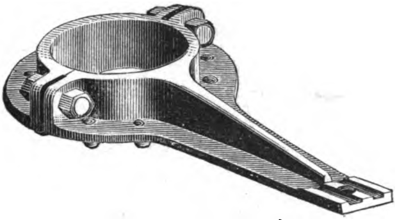
No. 12. Bolt for Bush Body to Crown Plate.

No. 13. Wooden Follower for Bush.

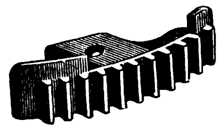


No. 14. Iron Plate for Bush.

No. 15. Set Screw for Follower.

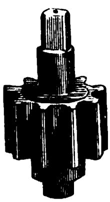


No. 16. Gate Rack Arm.

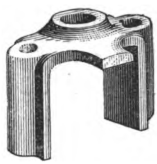


No. 17. Segment for Rack Arm.

No. 20. Bolt for Stirrup to Crown Plate.



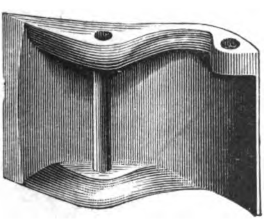
No. 18. Gate Pinion.



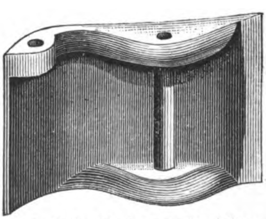
No. 19. Stirrup for Gate Pinion.

No. 21. Column.

No. 22. Bolt for Column.

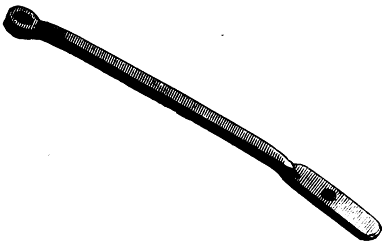


No. 23. Gate with Sun.



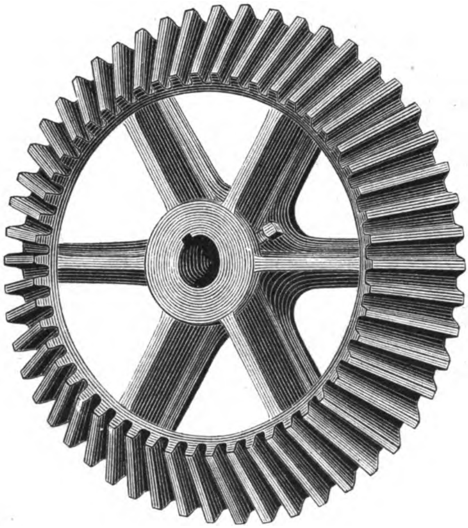
No. 24. Gate against Sun.

No. 25. Bolt through Gate.



No. 26. Gate Rod

No. 27. Bolt for Gate-Rod to Gate.



Our plant for the production of **Machine-Moulded Gearing** is entirely new, and is excelled by none in this country.

We are prepared to furnish all kinds of heavy Gearing at the shortest notice, from one to twenty feet diameter, of the most modern and approved proportions, equal in **Accuracy of Pitch** to Cut Gearing; and being enabled **to use the strongest irons** adapted to the purpose, of a quality entirely inadmissible in Cut Gearing, we feel confident, and our long experience warrants us in saying, we can furnish a **Cast** Gear that will run equally as well as a **Cut** one, and be much more serviceable in use.

Our Facilities for Shipping

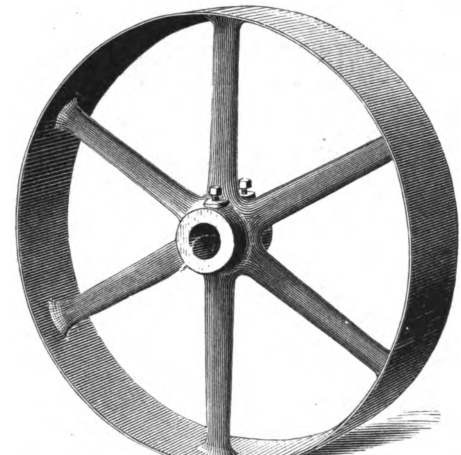
in any direction, and especially by outside lines to New York, Boston and Providence, and all southern ports, enable us to offer very liberal rates to Manufacturers, either for finished work or castings.

We shall be pleased to hear from any who are in need of anything in our line, and will promptly quote prices on receipt of specifications, etc.

POOLE & HUNT,

Baltimore, Md.,

U. S. A.



We are prepared to furnish Pulleys of the most modern and approved proportions (**finished or castings only**), of the following sizes:

5 in. diam.	1½ to 6 face	26 diam.	2 to 20 face	54 diam.	6 to 24 face
5½ " "	1½ " 6 "	27 "	2 " 20 "	55 "	6 " 24 "
6 " "	1½ " 8 "	28 "	2 " 20 "	56 "	6 " 24 "
6½ " "	1½ " 8 "	29 "	2 " 20 "	57 "	6 " 24 "
7 " "	1½ " 12 "	30 "	2 " 20 "	58 "	6 " 24 "
7½ " "	1½ " 12 "	31 "	2 " 20 "	59 "	6 " 24 "
8 " "	1½ " 12 "	32 "	2 " 20 "	60 "	6 " 24 "
8½ " "	1½ " 12 "	33 "	2 " 20 "	61 "	6 " 24 "
9 " "	1½ " 14 "	34 "	2 " 20 "	62 "	6 " 24 "
9½ " "	1½ " 14 "	35 "	2 " 20 "	64 "	6 " 24 "
10 " "	1½ " 14 "	36 "	2 " 20 "	66 "	6 " 24 "
10½ " "	1½ " 14 "	37 "	6 " 24 "	68 "	6 " 24 "
11 " "	1½ " 14 "	38 "	6 " 24 "	69 "	6 " 24 "
11½ " "	1½ " 14 "	39 "	6 " 24 "	72 "	6 " 30 "
12 " "	1½ " 14 "	40 "	6 " 24 "	75 "	6 " 30 "
13 " "	2 " 14 "	41 "	6 " 24 "	76 "	6 " 30 "
14 " "	2 " 14 "	42 "	6 " 24 "	78 "	6 " 30 "
15 " "	2 " 14 "	43 "	6 " 24 "	84 "	6 " 30 "
16 " "	2 " 14 "	44 "	6 " 24 "	90 "	6 " 30 "
17 " "	2 " 14 "	45 "	6 " 24 "	96 "	6 " 30 "
18 " "	2 " 20 "	46 "	6 " 24 "	102 "	12 " 36 "
19 " "	2 " 20 "	47 "	6 " 24 "	108 "	12 " 36 "
20 " "	2 " 20 "	48 "	6 " 24 "	114 "	12 " 36 "
21 " "	2 " 20 "	49 "	6 " 24 "	120 "	12 " 36 "
22 " "	2 " 20 "	50 "	6 " 24 "	126 "	12 " 36 "
23 " "	2 " 20 "	51 "	6 " 24 "	132 "	12 " 36 "
24 " "	2 " 20 "	52 "	6 " 24 "	138 "	12 " 36 "
25 " "	2 " 20 "	53 "	6 " 24 "	144 "	12 " 36 "

Any of the above made in halves when required.

We are prepared to make Balance and Band-Wheels, in segments, of any weight, face and diameter to 30 feet.

RULES FOR CALCULATING THE SPEED OF GEARS OR PULLEYS.

In calculating for Gears, multiply or divide by the number of teeth, as may be required. In calculating for Pulleys, multiply or divide by their diameter in inches.

The Driving wheel is called the **Driver,** and the Driven wheel the **Driven.**

PROBLEM I.

The revolutions of Driver and Driven, and the diameter of Driven being given, required the diameter of Driver.

RULE—Multiply the diameter of Driven by its number of revolutions, and divide by the number of revolutions of the Driver.

PROBLEM II.

The diameter and revolutions of the Driver being given, required the diameter of the Driven to make a given number of revolutions in the same time.

RULE—Multiply the diameter of the Driver by its number of revolutions, and divide the product by the required number of revolutions.

PROBLEM III.

The diameter or number of teeth, and number of revolutions of the Driver, with the diameter or number of teeth of the Driven being given, required the revolutions of the Driven.

RULE—Multiply the diameter or number of teeth of the Driver by its number of revolutions, and divide by the diameter or number of teeth of the Driven.

PROBLEM IV.

The diameter of Driver and Driven, and the number of revolutions of Driven being given, required the number of revolutions of the Driver.

RULE—Multiply the diameter of Driven by its number of revolutions, and divide by the diameter of the Driver.

SPECIAL NOTICE.

When you order Wheels or Pulleys give the **exact** diameter of the **bore** you require. If for rough castings, describe them thus:

To bore—no finish.

SIZE OF NAILS.

The following Table will show any one at a glance the length of the various sizes and the number of nails in a pound. They are rated "3-penny" up to "20-penny." The first column gives the number; the second, the length in inches; and the third, the number per pound—that is:

Inches	*Length in Inches*	*No. per Pound*	*Inches*	*Length in Inches*	*No. per Pound*
3-penny.	1	557	12-penny.	2	54
4-penny.	1¼	353	20-penny.	3½	34
5-penny.	1¾	232	Spikes.	4	16
6-penny.	2	167	Spikes.	4½	12
7-penny.	2¼	141	Spikes.	5	10
8-penny.	2½	101	Spikes.	6	7
10-penny.	2¾	68	Spikes.	7	5

From this Table an estimate of quantity and suitable sizes for any job of work can be made.

The speed at which Mill Stones should be run is

For 3 ft. stones 230 to 250 revolutions per minute.
" 3½ ft. " 200 " "
" 4 ft. " 180 " "
" 4½ ft. " 160 " "
Speed of Bolting Reels 30 to 35 " "
" Conveyers for flour 35 to 40 revolutions per minute.
" " " wheat 45 to 50 " "
" Elevators 30 to 35 revolutions per minute.
" Smut Machines from 550 to 700, according to size of Machine.

For **Merchant** Mills allow 20 horse-power to a pair of burrs (4 ft.), and the necessary machinery for cleaning and bolting; and for **Country** Mills about 10 horse-power to a pair of burrs.

For a single upright saw allow 10 horse-power, speed about 150 per minute.

For circular saws the best average working-speed is

650 to 700 per minute for 36-inch saw
600 to 650 " " 40 "
550 to 600 " " 42 "
525 to 550 " " 44 "
500 to 525 " " 48 "
475 to 500 " " 54 "
400 to 450 " " 60 "

A 60 saw-gin requires 6 horse-power to gin 500 lbs. of lint in 2 hours.

A Sumac Mill requires 15 horse-power.

Weight of Plate-Iron per Square Foot.

INCH.	LBS.	INCH.	LBS.	INCH.	LBS.
$\frac{1}{16}$	2.517	$\frac{5}{8}$	25.176	$1\frac{3}{8}$	55.387
$\frac{1}{8}$	5.035	$\frac{11}{16}$	27.694	$1\frac{1}{2}$	60.422
$\frac{3}{16}$	7.552	$\frac{3}{4}$	30.211	$1\frac{5}{8}$	65.458
$\frac{1}{4}$	10.070	$\frac{13}{16}$	32.729	$1\frac{3}{4}$	70.493
$\frac{5}{16}$	12.588	$\frac{7}{8}$	35.247	$1\frac{7}{8}$	75.528
$\frac{3}{8}$	15.106	$\frac{15}{16}$	37.764	2	80.563
$\frac{7}{16}$	17.623	1	40.282	$2\frac{1}{8}$	85.604
$\frac{1}{2}$	20.141	$1\frac{1}{8}$	45.317	$2\frac{1}{4}$	90.639
$\frac{9}{16}$	22.659	$1\frac{1}{4}$	50.352	$2\frac{1}{2}$	100.709

Table of the Capacity of Cisterns in Gallons, for each 10 Inches of Depth.

DIAM. IN FEET.	GALLONS.	DIAM. IN FEET.	GALLONS.	DIAM. IN FEET.	GALLONS.	DIAM. IN FEET.	GALLONS.
2	19.5	5	122.4	8	313.33	12	705.0
$2\frac{1}{2}$	30.6	$5\frac{1}{2}$	148.10	$8\frac{1}{2}$	353.72	13	827.4
3	44.06	6	176.25	9	396.56	14	959.6
$3\frac{1}{2}$	59.97	$6\frac{1}{2}$	206.85	$9\frac{1}{2}$	461.4	15	1101.6
4	78.33	7	239.88	10	489.2	20	1958.4
$4\frac{1}{2}$	99.14	$7\frac{1}{2}$	275.4	11	592.4	25	3059.9

The American Standard Gallon contains 231 cubic inches, or $8\frac{1}{3}$ pounds of pure water. A cubic foot contains 62.3 pounds of water, or 7.48 gallons. Pressure per square inch is equal to the depth or head in feet multiplied by .433. Each 27.72 inches of depth gives a pressure of one pound to the square inch.

Iron, under the influence of the hammer, and of constant use, gradually assumes, by repeated vibration, a different texture from that it had when the piece was new. The metal becomes crystalline, loses its tenacity, and becomes brittle.